



cavity possesses a local immunity. The mouth is one of the chief ports of entry of pathogenic micro-organisms. These organisms, however, frequently pass through the oral cavity without forming any focus locally and produce a primary lesion quite remote from the site of entrance into the body. It also is a well-recognized fact that patients with tubercle bacilli in the sputum or in the saliva rarely present tuberculous lesions involving the structures of the oral cavity. Considering the innumerable minor injuries frequently sustained by the mucous membrane of the oral cavity and the constant presence of micro-organisms in the mouth, one cannot but appreciate the existence of a high degree of specific local immunity of the oral mucous membrane.

Second, tuberculosis has its own sites of predilection. It attacks by preference the most cancellous portions of a bone, hence the frequent involvement of the metaphysis and the epiphysis of a long tubular bone. The flat bones, of which the mandible is one, are poor in cancellous tissue and, in general, are unfavorable for the settlement of tubercle bacilli. The rare occurrence of tuberculosis of the skull or of the scapula, for instance, as well as that of the mandible, further serves to illustrate this point. The influence of a lowered general resistance and an alteration of the local condition which favors the invasion of the mandible by the tubercle bacilli may be the factors which finally determine the localization of this infection.

It is to be noted that in all of the ten cases in which the chest was studied roentgenographically, tuberculous lesions involving the lungs or the pleura were found to be present; in six patients of this series tuberculous lesions (often multiple) were present in other bones. It seems evident, then, that in a great majority, if not all, of the patients suffering from tuberculosis of the mandible, a previous focus existed from which the infection spread to the mandible as well as to other bones by the hematogenous route. This does not mean to suggest the exclusion of the possibility of the invasion of the mandible by a neighboring lesion of the mucous membrane. This latter mechanism of invasion, however, would seem to be very rare. Controversy still exists with regard to the question of whether a carious tooth or an area of gingivitis may or may not be a portal of entry for tubercle bacilli causing a primary lesion in the mandible.<sup>3, 7</sup> Although the clinical evidence at hand seems to favor overwhelmingly the hematogenous route of infection of the mandible from a remote focus, one cannot very well deny altogether the fact that direct invasion through inflamed or injured gingivae is possible. It is the author's feeling that, if one maintains an open-minded attitude toward this question, no possible channel of infection of the mandible will be left uninvestigated. Also, proper oral and dental prophylaxis does not appear to be out of place in the general management of tuberculous individuals.<sup>4, 8</sup>

It is apparent that the roentgenographic diagnosis of tuberculosis of the mandible is difficult. In a district where tuberculosis is prevalent, if a young patient presents a slightly painful swelling of the jaw, following

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the shoulder to a right angle in full extension and the forearm in supination.

3. Flexion and extension with weight (usually ten pounds), with the arm by the side and the forearm in supination.

4. Flexion and extension with weight, with the arm abducted at the shoulder to a right angle and the forearm in supination.

Of the nine patients treated by the technique described (Cases 28 through 36), all but one had a normal functioning elbow. In the one case in which the result was unsatisfactory (Case 30), the patient left the Hospital during the course of treatment. When, after repeated letters had been sent to him, he reported for inspection, he had flexion to 70 degrees and extension to 130 degrees.

#### SUMMARY

The treatment of recent dislocations of the elbow is simple, and the results are satisfactory, if the principles which have been enumerated are strictly followed. The most important complication arising from a dislocation of the elbow is the formation of new bone (myositis ossificans), which can be prevented. When a dislocation remains unreduced, or when the elbow is fixed, due to the formation of new bone, excision of the elbow by the method described has given satisfactory results.





any friction over the contusion, even that from clothing, should be prevented. This stage is that of acute inflammation,—“acute myositis”. The treatment should then be rest and heat, with elevation of the inflamed part. The stage of ossification does not become discernible until between the sixteenth and the twenty-first day, and then only with the aid of the roentgen ray. The inflammatory reaction subsides gradually in a few days, and then limited motion, up to the point of pain, can be permitted, and, instead of complete rest, gradual ambulation and motion are started. Heat, however, should be applied daily and regularly, until the muscle function has been restored. As the ossification commences its absorption or regression, the inflammatory myositis subsides, and normal function is restored to the muscle. At this point, it is safe to permit the patient to resume normal activities, even to allow body-contact sport, provided the original site of injury is properly protected from further contusion. Repeated trauma to this site results in increased ossification of the area and a prolonged period of convalescence.

It is the author's profound belief that it is not only the type and severity of the original contusion, but also the diathesis of the patient that produces “myositis ossificans traumatica”. The preventive measures are those primarily designed to protect the individual from the possibility of obtaining such injuries in sports,—proper padding and such protection as is permitted by sport rules and regulations. The second important point in prevention is the immediate institution at the time of the injury of proper measures to control hemorrhage,—that is, the application of cold for one hour and the use of a compression bandage with sponge rubber. The third point is the ruling out of massage in the early treatment of all deep-muscle contusions. Greater areas of ossification have been produced by overenergetic massage in the early treatment of ordinary muscle contusions. It is a far safer rule never to apply massage directly to the area of tenderness in a muscle contusion.



FIG. 5

Case 20. Tibia, twelve weeks after injury.

# The Journal of Bone and Joint Surgery

## SPONDYLOLISTHESIS

OBSERVATIONS ON ITS DEVELOPMENT, PROGRESSION, AND GENESIS \*

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### INTRODUCTION

The term "spondylolisthesis" is now almost universally limited in its use to describe a forward displacement of the vertebral column consequent to a defect or solution of continuity in the interarticular portion of the neural arch of a vertebra,—a "spondyloschisis" or "spondylolysis" interarticularis. Since the introduction of these terms,—the former by Kilian in 1854 and the latter by Neugebauer in his classical monograph published in 1892—an extensive and voluminous literature has grown up around this subject. Nevertheless, a number of fundamental questions related to the genesis of the spondylolysis and the development of the spondylolisthesis remain as yet unanswered.

### THE DEVELOPMENT OF THE SPONDYLOLISTHESIS

The majority of contributors have either assumed or factually stated that the listhesis is slowly progressive in character, and the continued use of the term "prespondylolisthesis" † infers a tacit assumption of this nature. Sisefsky, in making a plea for the restricted use of the term spondylolisthesis in conjunction with spondylolysis, says ". . . it is generally held to be characteristic also that the dislocation should take place slowly and gradually". However, many authors consider trauma as a necessary part of the mechanism which determines the spondylolisthesis, but in a great many cases no history of trauma can be ascertained, and, furthermore, the evidence from this source is decidedly equivocal. Huber denies the rôle of trauma as the unique cause of the slipping on the ground that there exists no description of any case in which roentgenographic examination showed positively no changes before the trauma.

\* Read at the Annual Meeting of the American Orthopaedic Association, Buffalo, New York, June 6, 1939.

† The term "prespondylolisthesis" is used here not in the sense as originally introduced by Whitman (1924) but as employed by later authors.

one instance. These cases, as has been said, present typical clinical findings of supraspinatus-tendon laceration. There was lost or greatly diminished initiation of abduction with inability to raise the shoulder, but there was power to maintain elevation once it had been secured. A sulcus and an eminence could be palpated, although localized tenderness and pain made such examination untrustworthy. Although active motion was lost completely, passive motion was present, except in one case of one month's duration, with associated cortical avulsion of the teres minor. This latter case presented such spasm and protection that passive manipulation was impossible. There was no snap on motion; instead there was an actual block as the tuberosity struck the edge of the acromion, and this could be unlocked by traction on the arm and depression of the humeral head. As all three cases had existed less than six weeks and were in heavily muscled or stout individuals, atrophy of the short rotators could not be accurately estimated. No question as to diagnosis could be raised in these cases, and, except that preoperative diagnosis tended to minimize the extent of laceration found, no unexpected pathology was disclosed. Opening of the bursal roof directly exposed the humeral head, the bursal floor having been cleanly torn and retracted intact with the tendon. In the case where cortical avulsion of the teres minor was present, the cortical fragment had partially reossified to a new bed, leaving a three-eighths-inch gap of bare cancellous bone between it and the posterior margin of the greater tuberosity. No roentgenographic evidence of this avulsion was demonstrable. The supraspinatus and the infraspinatus tendons remaining attached to each other had retracted upward and backward and had torn free from the raphe of the rotator-tendon cuff at their anterior and posterior margins. Perhaps the most important gross finding was in the remaining two cases of complete rupture of the supraspinatus and the infraspinatus tendons alone. In both of these the two tendons remained attached to each other, but the anterior border of the supraspinatus tendon had torn loose from the cuff, and the pull of the infraspinatus had caused the anterior corner to pass upward and backward under the acromion, so that the lacerated margin lay vertically in the coronal plane. The result was that no amount of searching for the tendon of the supraspinatus upward under the acromion could have located it. It was, however, simple, with the wide exposure present, to reach backward under the acromion and to pull the lacerated margin downward and forward into contact with its original insertion. In all of these lesions very little hemorrhage was present, and there was no evidence of fibrosis or of repair. The articular cartilage of the humeral head seemed to have degenerated near the tuberosity defect and to have receded one-eighth of an inch or so from it, leaving a line resembling granulation tissue between the articular surface of the head and the degenerating tendon fibers still attached to the upper border of the tuberosity. Degeneration of tendon substance in the proximal avulsed margin seemed less than in those cases where laceration had involved the full

An extensive search of the literature has failed to reveal the records of a single case which showed any progression of the listhesis from one examination to the next.\* This fundamental and extraordinary lack of any objective proof of the progressive nature of the slipping, in spite of the many hundreds of observations on spondylolisthesis, is echoed by Silfverskiöld, who, in discussing a paper of Wallgren's says: "As far as I have been able to find out from the literature, there is as yet no record of any gliding having taken place from one occasion to the other. In none of the cases that I have followed, several of which were of mild to moderate degree, has there been any increased amount of gliding since the first examination. It may be that several factors are necessary for such recording to be done; the proof, however, would still seem wanting." Obviously, before the advent of roentgenography, such observations were not practical, but nowadays, if the slipping takes place slowly and progressively during postnatal life, proof of its nature should be forthcoming.

The following case histories and roentgenograms, it is believed, present for the first time unequivocal evidence of the progress of the listhesis.

CASE 1. E. E., female, aged four years, was first seen in 1929 with some pain in her back. Roentgenographic examination (Fig. 1-A) showed a spondyloschisis in the fifth lumbar vertebra, but no spondylolisthesis. After tonsillectomy, the pain disappeared, and the patient was not seen again until February 1937. At this time she stated that she had sat down hard while roller skating, and she complained of pain in the lower back, which radiated down the posterior aspect of both thighs. Roentgenographic examination (Fig. 1-B) showed a degree of spondylolisthesis.

A spinal fusion was done on March 8, 1937. The patient was last seen on March 1, 1938, at which time she had made a complete recovery, and roentgenograms showed a solid fusion of the grafts bridging from the fourth lumbar vertebra to the sacrum.

CASE 2. D. B., female, aged thirteen years, was seen by Dr. George Lyman in 1927 at the age of eleven, and roentgenograms (Fig. 2-A) of her back showed a marked spondylolisthesis. The intervertebral disc between the fifth lumbar vertebra and the sacrum had disappeared, and the fifth lumbar vertebra had slipped forward a distance of about one-half the width of the sacrum.

The author first saw the patient on March 26, 1929, at which time roentgenographic examination (Fig. 2-B) showed that there had been a further slipping and that the fifth lumbar vertebra had slipped forward the full width of the sacrum. The patient was having severe pain in the lower back, which radiated down the posterior aspect of both thighs.

A spinal fusion, with grafts from the tibia, was done on May 21, 1929. Convalescence was uneventful. The patient was last seen in 1937, at the time of her graduation from college. There had been no further recurrence of symptoms.

CASE 3. Mrs. D. C. W., female, aged forty-five years, a housewife, was first seen by the author on October 11, 1935. She had pain in the lower back, which radiated down the posterior aspect of both thighs. Frequently, after sitting, she was unable to straighten up and had to walk in a bent-over position. Roentgenograms (Fig. 3-A), taken in 1932, showed an isthmie defect of the fifth lumbar vertebra with a slight degree of spondylolisthesis. Roentgenograms (Fig. 3-B), taken in 1935, showed a considerable progression of the listhesis and disappearance of the intervertebral disc. A fusion operation was advised, but was refused.

\* Since this paper was submitted, a number of these cases have been reported by Sten Friberg in *Acta Chirurgica Scandinavica*.

# A COMPOUND FRACTURE OF THE SHAFT OF THE HUMERUS WITH ONE HUNDRED AND EIGHTY DEGREES' ROTATION OF THE LOWER FRAGMENT WITHIN THE ELBOW JOINT

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The unusual displacement of the lower fragment in a compound fracture of the shaft of the humerus prompts the following report.

G. S., a twelve-year-old, white, American schoolboy, was admitted to the University Hospital on April 3, 1937, complaining of a fractured right arm. About three hours before admission the patient's arm had been severely twisted by a belt which operated a buzz saw. The resulting force threw the boy upward into the air and he landed upon his back, a few feet away. His wounds were covered with sterile dressings, and his arm was secured to a board splint.

Except for the right upper extremity, the examination was negative. The medial aspect of the upper arm presented a vertical, gaping laceration, five inches long. There was a fracture of the mid-shaft of the humerus, and both fragments protruded from the wound. Moderate swelling was found in the region of the elbow, and there was acute tenderness about the lateral and medial epicondyles. Fractures of the shafts of the radius and the ulna were obvious. The radial pulse was of good quality. Hypaesthesia was noticed in the distribution of the median nerve in the hand. The patient was unable to extend the thumb or the metacarpophalangeal joints of the fingers. Hyperaesthesia was found in the area of the hand supplied by the radial nerve.

Röntgenographic examination of the right upper extremity revealed a transverse fracture of the middle third of the humerus, a fracture at the base of the medial epicondyle of the humerus, the suggestion of a minimal chip fracture of the lateral humeral epicondyle, a fracture at the junction of the middle and distal thirds of the right radius, an oblique greenstick fracture at the junction of the proximal and middle thirds of the ulna, an oblique fracture at the junction of the middle and distal thirds of the ulna, and a fracture of the ulnar styloid process.

Closer inspection of the roentgenograms disclosed an extraordinary displacement of the lower humeral fragment, which had been rotated 180 degrees, so that its anterior surface faced posteriorly. This rotation had occurred not only in relation to the upper fragment but also in relation to the radius and the ulna. The capitellum was articulating with the semilunar notch of the olecranon process, while the radial head was apposed to the trochlea. The medial epicondyle was opposite the lateral condyle (Fig. 1).

Trophic doses of tetanus antitoxin and gas-bacillus antitoxin were administered soon after admission. The wounds were explored under general anaesthesia. The humeral fragments had been compounded between the anterior and posterior muscle groups without obvious damage to the brachial vessels or to the median, ulnar, or radial nerves. The wounds were carefully debrided and irrigated with quantities of physiological saline solution. There was no gross contamination. The lower humeral fragment was derotated 180 degrees without undue difficulty, the fracture was reduced, and the fragments were fixed by a single stainless-steel wire passed through drill holes in both fragments. The wounds were closed loosely.

The fractures of the medial epicondyle and of the forearm were manipulated into



Fig. 1-A

Case 1. E. E., female, aged four. Film taken in 1929. Note the defect in the isthmus region of the fifth lumbar vertebra and the smooth curve formed by the backs of the bodies of the lumbar vertebrae and the sacrum. No listhesis has taken place.

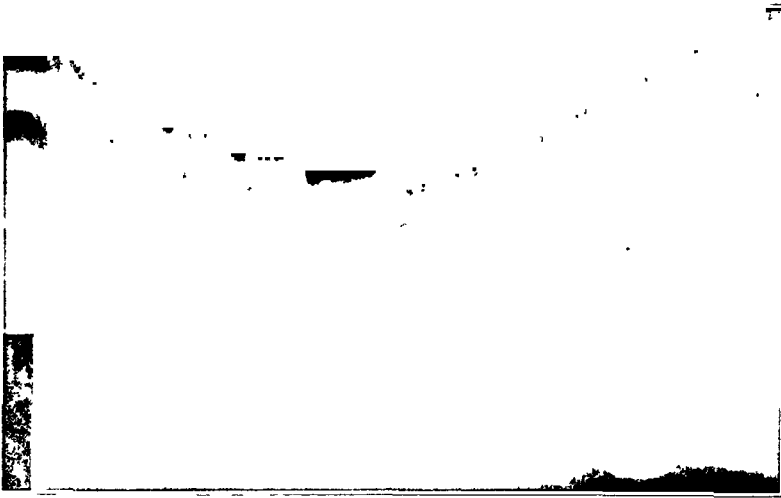


Fig. 1-B

Case 1. E. E., aged twelve. Film taken in 1937. The defect in the isthmus is more marked. The fifth lumbar vertebra has slipped forward, making a defect in the smooth curve formed by the backs of the bodies of the lumbar vertebrae and the sacrum.



Fig. 1-C

Case 1. E. E., aged twelve. Film taken in 1937 clearly shows the defect in the isthmus and the fusion bridging from the fourth lumbar vertebra to the sacrum.

places in his first group; these are typical cases of chondrodysplasia. The second group consists of two sisters, one of whom is a typical example; the other sister is atypical, suggestive of the lesion only and presents multiple mild disturbances of epiphyseal nature. The third group consists of two cases in which multiple abnormalities in cartilage growth are revealed. On the basis of roentgenographic findings in the vertebrae, the pelvis, and the knees, which are similar to those seen in chondrodysplasia, the author suggests that these are atypical cases, and indicates that all varieties of fleeting transitional types probably exist.—*Joseph E. Milgram, M.D., Brooklyn, New York.*

SPÄTERGEBNISSE VON SEHNENNÄHTEN AN ARM UND HAND (End Results in Tendon Suture of Arm and Hand). Fritz Heck. *Archiv für orthopädische und Unfall-Chirurgie*, XXXIX, 21, 1939.

The author considers the question of the advisability of primary or secondary suture of severed tendons. He reviews the previous statistics of such groups and emphasizes the difference of opinion existing in well-informed circles. By far the largest series of tendon sutures is that of J. O. von Zweigbergk of Sweden, who reported 688 tendon sutures. In 651 cases of primary suture good results were obtained in 80 per cent. of the extensor tendons and in 45 per cent. of the flexor tendons. In thirty-two cases of secondary suture, good results were secured in twenty-two of twenty-five extensor tendons and in six of seven flexor tendons. The results in the remaining cases were bad.

The author then presents his own series of seventy-five cases of tendon injuries of the hand at the *Würzburger Klinik*.

Primary suture was carried out on the extensors thirty-one times; on the flexors, twenty-three times; and on both, five times. Good results were obtained in 64.6 per cent. of the extensors and in 43.4 per cent. of the flexors.

Secondary suture was carried out sixteen times (eight extensors and eight flexors). In the case of the extensors this procedure was successful in 62.5 per cent.; while in the case of the flexors it was successful in only 25 per cent.

In general, the author prefers primary to secondary suture which he reserves for tendons which have suffered extensive soft-tissue damage.—*Joseph E. Milgram, M.D., Brooklyn, New York.*

SPONTANFRAKTUR DES RECHTEN OBERARMES BEIM HANDGRANATENWURF (Spontaneous Fracture of the Right Humerus in Throwing a Hand Grenade). Victor Krainz. *Archiv für orthopädische und Unfall-Chirurgie*, XXXIX, 429, 1939.

Spontaneous fracture of the humerus "in throwing hand grenades for sport" has already been reported. In the last and present wars, Küttner, Seidel, Warstat, Kayser, Hülse, and Kehl have reported cases. The mechanism is presumably a discoordinated series of muscle contractions, the pectoralis major being the immediate breaking cause. A spiral fracture with a free middle-third fragment usually occurs.

The author reports a case in a male, twenty-five years of age, a master grenade thrower, who had won honors with a throw of seventy meters. The fracture occurred after a non-competitive throw of forty-five meters. Union was slow.—*Joseph E. Milgram, M.D., Brooklyn, New York.*

GRUNDSÄTZLICHES ÜBER DIE BRÜCHE DES OBERARMKOPFES (Fundamentals of Fractures of the Humeral Head). Ernst Deline. *Archiv für orthopädische und Unfall-Chirurgie*, XXXIX, 434, 1939.

The author discusses the numerous problems involved in treatment of fractures of the humeral head and the upper end of the humerus, basing his experience on a group of 300 cases treated by himself and Felsenreich. He discusses essentially the abduction type of fracture and the dorsiduction type.



## DISCUSSION

The roentgenograms of these cases present examples of spondylolisthesis in which may be found undoubted objective evidence of progressive forward migration of the vertebral column. The first case, that of a young girl first seen when four years old, is of exceptional interest. At the initial examination the roentgenogram revealed the presence of an isthmic defect alone, without the remotest suggestion of any listhesis. Over a period of eight years, the prespondylolisthetic condition progressed to a frank spondylolisthesis (grade 1 in Meyerding's classification), with marked increase in the interval between the pedicles and the separated laminae of the affected vertebra. In the second case, a definite spondylolisthesis (grade 3) was present at eleven years of age, which, in less than two years, progressed and became complete (grade 4). In the third example, occurring in an adult, progression from grade 1 to grade 2 was obvious in three years. It is to be noted that in none of these cases was trauma a significant feature, nor was it sufficient to account for the progression of the listhesis.

In all of these cases progression of the listhesis was accompanied in greater or lesser degree by roentgenographic evidence of thinning of the related intervertebral disc. This

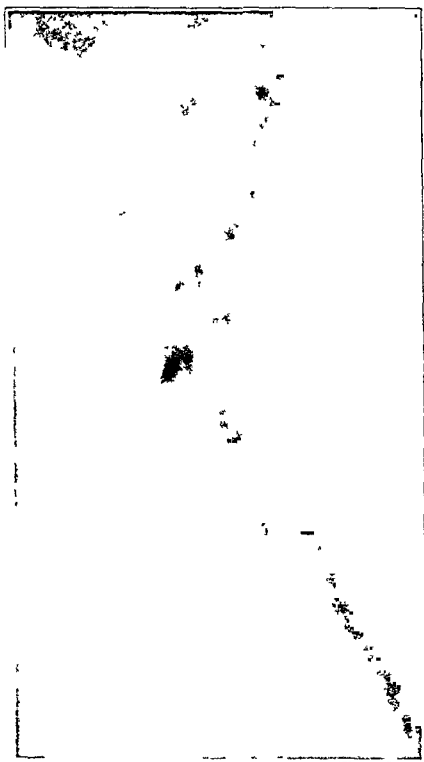


FIG. 2-A

Case 2. D. B., female, aged eleven. Film taken in 1927 shows disappearance of the fifth intervertebral disc and marked spondylolisthesis. The fifth lumbar vertebra has slipped forward half the width of the sacrum.

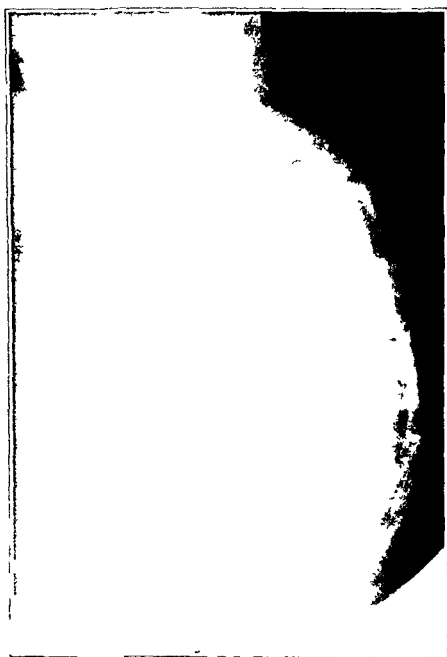


FIG. 2-B

Case 2. D. B., aged thirteen. Film taken in 1929 shows further spondylolisthesis. The fifth lumbar vertebra has slipped forward the full width of the sacrum.

unless the indication is for amputation. A small incision for the removal of a piece of shell should be made and, if possible, Carrel's tubes should be introduced.—James W. Toumey, M.D., Boston, Massachusetts.

**WAR WOUNDS AND AIR RAID CASUALTIES. AMPUTATIONS UNDER WAR CONDITIONS.**  
C. Max Page. *British Medical Journal*, II, 77, 1939.

In former times amputations formed the major part of war surgery, and now they are an important section of this work. In the pre-antiseptic period gross suppuration was the rule. The current practice in England is molded from the study of 50,000 amputations in the past War. It must be admitted that the problem of the "phantom limb" and that of painful nerve bulbs still exist.

Primary amputation should be done in those cases where missile injury and comminution of the bone are such that prolonged bone infection and delayed union are liable to occur, especially in those instances where damage is done to the lower half of the leg. Otherwise the patient will require long years of surgical treatment, and the end result will be for the most part unsatisfactory. In the lower limb, a good stump, in which suppuration has not occurred, can be fitted very satisfactorily with a prosthesis. The same attitude toward compound fractures in the upper limb is not justified, as nothing can satisfactorily replace a hand.

Long flaps tend to be unsatisfactory from the point of view of nutrition. The circular flap is the ideal type. The end of the stump should be tapered and not bulky. Projection of bone of small diameter, such as the fibula, is a very undesirable feature in a stump. The periosteum should be cleanly cut away before the bone is sawed through. Nerves should be cut an inch or so above the line of section of the muscle. Ligating the nerve is not favored. The nerve may be injected with 90-per-cent. alcohol before the flaps are closed. From practical experience, ligating the vein and artery together gives satisfactory results. The guillotine operation is seldom necessary, even in the presence of sepsis below the knee. In such a case, a short circular flap is advocated. Drainage of all stumps with a rubber dam for twenty-four hours is advised. The author does not favor the Stokes-Gritti amputation. In many cases the Syme amputation is unsatisfactory, and the patient must undergo reamputation later. The ideal bone section below the knee should leave six inches of tibia in the average adult and seven inches in a tall person. The shortest below-knee stump of functional value is about three inches. Above the knee, the seat of election is nine inches below the crotch in a short person and ten inches for a tall patient. Greater length than this impedes the fitting of the best type of modern limb. After amputation, flexion at the hip or knee should be avoided. In the thigh, a temporary pylon is applied a month or so after amputation. The ideal forearm amputation retains six or seven inches of radius and ulna. In the upper arm, the humerus should be divided some two inches above the epicondyles.—James W. Toumey, M.D., Boston, Massachusetts.

**OBSERVATIONS ON THE RECOGNITION OF SOME FORMS OF BONE AND JOINT TUBERCULOSIS.**  
J. V. De Los Santos. *The Bulletin of the Quezon Institute* (Manila), I, 63, 1939.

The author emphasizes the high incidence of pulmonary tuberculosis in the Philippine Islands, and with it the complication of osseous tuberculosis. The presence of tubercle bacilli in the bone marrow does not necessarily mean disease or tuberculous destructive processes in the bone (Randerath). Krause and König observed wedge-shaped tuberculous areas in bone due to infected emboli.

The author divides the cases into three groups and cites descriptive cases:

Group I—Cases showing the lesion as a single cavity;

Group II—Cases with multiple cystic lesions (Jüngling);

Group III—Diffuse tuberculous arthritis with osseous cavitations.

Cyst-like defects, single or multiple, may be present in some forms of bone and joint



FIG. 3-A

Case 3. Mrs. D. C. W., aged forty-two. Lateral view of lumbosacral region taken in 1932, showing slight spondylolisthesis with the fifth disc intact.



FIG. 3-B

Case 3. Mrs. D. C. W., aged forty-five. Film taken in 1935 shows further slipping and disappearance of the disc between the fifth lumbar vertebra and the sacrum.

is a feature in spondylolisthesis which must be regarded as of considerable importance not only in the development of the listhesis itself but also in the development of an osseous barrier to hinder further progression of the slipping.

Müller, whose views are reemphasized by Silfverskiöld, has already called attention to the bearing which degeneration of the intervertebral disc has upon the occurrence of dislocation between the vertebrae. He considers that the disc is of more importance than the intervertebral articulation in preserving the integrity of the spine, and he finds confirmation of this view in the case of a man of thirty-six, in whom the inferior articular processes of the second lumbar vertebra were congenitally absent without the slightest influence upon the function or position of the spine. However this may be, evidence of degeneration of the disc in spondylolisthesis constitutes a common characteristic.

For the prevention of the further development of the condition, the importance of the bony excrescences which are readily discernable in roentgenograms of well-marked cases of spondylolisthesis has been well recognized. Lambl was so impressed with this function that he introduced the term "*torus promontoralis sustentaculum*". Turner and Tchirkin comment upon this mechanism, which they regard as the result of thickening of the anterolateral ligaments in which osteophytic outgrowths occur. It has not, however, been recognized with any clarity

There was an almost normal range of flexion and extension in the hip, and the result was very satisfactory.—Louis W. Breck, M.D., *El Paso, Texas*.

**PSEUDO-ARTROSIS DEL HÚMERO A REPETICIÓN, COMPLICADA CON PARÁLISIS IRREPARABLE DEL NERVO RADIAL. OSTEOPLASTIA CURATIVA Y RECONSTRUCCION FUNCIONAL DE LA MANO POR TRANSPLANTACIONES TENDINOSAS.** (Recurrent Pseudarthrosis of the Humerus, Complicated by Permanent Paralysis of the Radial Nerve. Osteoplasty and Functional Reconstruction of the Hand by Tendon Transplantations.) Alberto Inclán. *Cirugía Ortopédica y Traumatología*, VII, 43, 1939.

The author reviews thirty cases of non-union in fractures of the humeral shaft, treated by autogenous inlay bone grafts according to the technique of Albee.

The incision recommended by the author is begun anterolaterally on the arm and is drawn downward and slightly medially to terminate on the anterior aspect. The bone is reached by blunt dissection of the brachialis, care being taken not to dissect or to retract the radial nerve. Long, thick, tibial grafts are preferable. The inlay graft, secured by kangaroo-tendon sutures, is anatomical and provides good fixation. In cases in which there is good alignment of the fragments, resection of their ends and of the interposed fibrous tissue is not necessary, for the wide cut made with the twin saw to accommodate a thick graft removes a sufficient amount of sclerosed tissue without producing shortening of the bone. In cases in which marked atrophic changes in the fragments have occurred, the ends of the latter should be removed and the graft placed as a bridge between them. A plaster cast should be prepared beforehand to minimize the amount of stress placed on the graft after its insertion. Postoperative immobilization should be maintained until solid union has been demonstrated roentgenographically.

Fracture of the graft, due to premature mobilization was observed in four cases. In two of them union was obtained after another period of immobilization. In the third case an operation was necessary. The fourth patient refused operation and this case was the only failure in the entire series.

The author reports a case of fracture of the humerus with non-union, in which three unsuccessful operations had been performed elsewhere. Division of the radial nerve had remained unnoticed until four months after the last operation, when removal of the plaster cast revealed the presence of a paralytic drop-wrist. The first attempt at suturing the radial nerve was unsuccessful. At the second operation a bone graft was implanted and after union had been obtained the patient left the hospital, wearing a protective plaster which left the shoulder free. Forced abduction resulted in fracture of the graft. A thicker and larger graft was then inserted, and the patient was kept in the hospital until solid union was obtained. To secure improvement in the functional capacity of the hand, the tendons of the flexor carpi radialis, the palmaris longus, and the flexor carpi ulnaris were transplanted to the extensors and the abductor of the thumb and to the extensors of the digits and the carpus.

**REVISIÓN DE LOS CASOS DE PARÁLISIS INFANTIL ATENDIDOS EN EL SERVICIO DE POLIO-MIELITIS DEL HOSPITAL MERCEDES. DEDUCCIONES DEL ESTUDIO DE QUINIENTOS CASOS TRATADOS DURANTE CINCO AÑOS.** (Review of Cases of Infantile Paralysis Treated on the Poliomyelitis Service of the Mercedes Hospital. Deductions from the Study of 500 Cases Treated During a Five-Year Period.) Isidoro Pascau y Raoul Rodríguez. *Cirugía Ortopédica y Traumatología*, VII, 58, 1939.

After a careful check-up of 500 cases of infantile paralysis, the authors found that fourteen patients were completely cured; eighty-six had the full use of one extremity; 275 had noted some improvement; seventy-five did not show any change in their condition; four were worse; and forty-six did not return for examination. Additional findings were as follows:

that the buttress which develops anteriorly is formed in large measure by the dislocation of the intervertebral disc itself or that the osteophytic or calcified deposits develop within the annulus fibrosus of the displaced disc. Even in cases in which no osteophytic formation has occurred, the soft-tissue shadow of the displaced disc can often be distinguished. It would appear that dislocation of the disc to a varying degree is an essential concomitant of the listhesis. Through the courtesy of Dr. J. B. Saunders, the writer has had the opportunity of examining a post-mortem specimen of spondylolisthesis which demonstrates this point admirably.

It would seem that the development of the listhesis is accompanied by a dislocation of the related intervertebral disc, which undergoes progressive degeneration. The displaced mass of the disc may, by further changes in the nature of calcification with eventual ossification, hinder further slipping.

#### THE GENESIS OF THE SPONDYLOSCHISIS (SPONDYLOLYSIS)

It is now generally, if not universally, recognized that the fundamental lesion which precedes and results in a spondylolisthesis is an interruption in the continuity of the neural arch. Such defects are found with remarkable constancy in the narrow isthmic or interarticular portion of the neural bow at the junction of pedicles and laminae. In the great majority of instances the defect is bilateral, but in a few it is unilateral. When bilateral, the body, the pedicles, and the superior articular processes are separated from the laminae, the spine, and the inferior articular processes, and, as a consequence, the security of the column is diminished through interference with the solidity of its bony anchorage.

Before discussing the genesis of the spondyloschisis, it is perhaps necessary to mention the incidence and frequency of the condition. Defects of this nature are common to all races. Instances have been found all over Europe, among the Bantu (Shore), in Japanese (Hasebe), in American aborigines (Congdon), in Eskimos (Stewart), and in Americans and American negroes (Willis). Allowing for differences in sampling, it would seem that the frequency in unselected material is approximately 5 or 6 per cent. Observations are now sufficiently extensive to establish an almost equal incidence between the two sexes and to correct earlier erroneous views that the defect predominates in the female. The condition has been found at all ages in the postnatal period and on several occasions in quite young children, although the case of E. E., aged four years, discussed in a preceding section, would appear to be the youngest example so far reported. The defect is found most frequently in the last lumbar vertebra, less frequently in the penultimate lumbar vertebra, and very occasionally at other levels. Exceptional cases in which two vertebrae have shown the defect are described. In these examples the defect invariably occurs in adjacent vertebrae of the lower lumbar region.

The exact etiology of the defect has been a matter of considerable discussion. It has been ascribed to local inflammatory change, to trauma

femoral artery in a series of dogs. The controlled effects of the various operations were then recorded by means of arteriographic plates. The authors conclude that:

1. Lumbar sympathectomy results in the greatest development of a collateral circulation.
2. Novocain infiltration of the lumbar sympathetic nerves is equally satisfactory in effecting a collateral circulation.
3. Intra-arterial injection of novocain may in some cases yield a slight augmentation in the collateral circulation. In the majority of cases no result was obtained.
4. Unilateral resection of the splanchnic nerves is of no value.—*Henry Milch, M.D., New York, N. Y.*

LE TRAITEMENT DES ALGIES DES AMPUTÉS PAR LA VITAMINE B<sub>1</sub> SYNTHÉTIQUE (Treatment of Pain in Amputation Cases by Synthetic Vitamin B<sub>1</sub>). A. Sliosberg. *La Presse Médicale*, XLVII, 1589, 1939.

Patients who have been submitted to amputation may complain of non-painful sensations in the phantom extremity, or they may suffer true pain. This pain may come on at any time after amputation; in some cases, immediately; in others, more than twenty years later. The pain may be continuous or paroxysmal. It may be situated at the level of the amputation or in the phantom toes. In addition, these patients may suffer from reflex pains in other members.

Vitamin B<sub>1</sub> has been successfully employed in the treatment of other types of pain, and, on this basis, the author has used it in the treatment of post-amputation pain. Of eighty-four cases in which it was used, sixty-seven are discussed. In eleven cases there was 100 per cent. relief of pain; in thirty-nine, from 50 to 90 per cent. relief; in ten, from 30 to 40 per cent. relief; and in seven, only from 10 to 20 per cent. relief. In addition to this subjective amelioration, in three cases a definite reduction of arterial hypertension was observed. Forty-six of the sixty-seven patients were markedly improved by five or fewer injections. The author noted that, in the cases which showed complete cure, the improvement was observed after the first injection; while in those in which the cure was less complete, the response was longer delayed.

Injections of one centigram of vitamin B<sub>1</sub> were given subcutaneously every other day. Larger doses were useless and occasionally aggravated the symptoms. In the paroxysmal cases, intravenous use of the drug occasionally aborted a crisis.

The author believes that the vitamin acts as a true drug by assisting in the elimination of those intermediate products of carbohydrate metabolism which are toxic to nerve fibers.—*Henry Milch, M.D., New York, N. Y.*

CLINICAL AND NEUROLOGICAL ASPECTS OF LOW BACK AND SCIATIC PAIN. Maurice N. Walsh. *Radiology*, XXXIII, 681, 1939.

It is probable that congenital anomalies are rarely the cause of sciatic or of low-back pain. Posterior protrusions of the intervertebral discs are believed to be traumatic in origin and in some cases they are probably the result of several injuries rather than of only one. Hypertrophy of the ligamenta flava was found in 155 of 175 cases of posterior protrusion of intervertebral discs. It is believed that this hypertrophy was due to the trauma that produced protrusion of the disc. Protrusion of a disc should be sought whenever hypertrophy of the ligamenta flava is found. Also, facet changes may be caused, either immediately or as sequelae to the same trauma.

Tumors of the spinal cord or cauda equina and metastatic tumors may give rise to sciatic pain, and may do so even when located in the thoracic or the cervical region. Idiopathic "sciatic neuritis" and radiculitis of the cauda equina are both rare in the author's experience. Psychogenic factors may be important contributing elements.

The investigation of low-back and sciatic pain should begin with a careful history of the type and origin. Next it is important to determine whether or not the pain is

and mechanical factors, and to the presence of anomalous centers of ossification or to defects in ossification. Of these views, that of local inflammatory change as an etiological factor has been rightly discarded for complete lack of evidence.

The view that has received the widest support and, by many authors, complete acceptance is the conception that the defect is congenital. This opinion is held by two groups: first, those who follow Neugebauer and regard the lesion as the result of failure of fusion between two centers of ossification from which each lateral half of the neural arch is supposedly formed; and, second, those such as Willis (1931), who conceive the lesion to be the result of imperfect ossification either by failure of the ossific process itself or by a defect in the preexisting cartilage. Several proponents of the congenital theory, however, recognize the weakness of the evidence on which it is based. Nevertheless, it is felt that, because of its general acceptance, this theory should be discussed and the results of recent investigation should be added.

The contention that each lateral half of the neural arch ossifies from two centers undoubtedly springs from the work of Rambaud and Renault (1864). The work of these authors is of great importance for the history of anatomy, as the majority of statements on centers of ossification made in the standard textbooks of today can be readily traced to it. For these reasons and because their monograph is rare, their statements and an illustration of the ossification of the spine are given. They state (page 73) that "the vertebral column presents in the middle line, by transparency, a series of median centers (points) *A* [Fig. 4]; then, laterally and on either side, two other rows of centers. The first row, *C*, is well behind the canal and is the most conspicuous and the most developed. More anteriorly and a little medially, between the median row *A* and that just described, we find another row of centers, *B*, less developed and placed in such a way as to alternate with those which form the preceding row. The centers in the most posterior row are destined to form all of the laminae proper; those in the anterior row, the

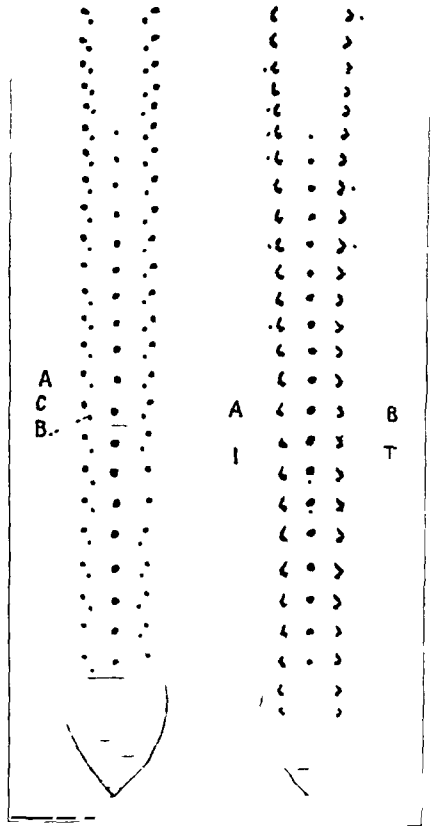


FIG 4

Enlarged from Figs 3 and 4 in Plate 4 of Rambaud and Renault (See text)



FIG. 5

Photograph ( $\times 10$ ) by oblique illumination of specimen cleared by Skarda's technique, showing anterior aspect of a fifty-millimeter embryo, with ossific centers in the cartilage matrix.

largely discredited by Mall (1906) and in other particulars by Inman and Saunders (1937); nevertheless their opinions die hard. The multiplicity of ossific centers for all parts of the skeleton which these earlier observers described has never been confirmed, and it is now recognized that their erroneous observations were the outcome of artefacts created by the imperfection of the methods used in the preparation of material.

Discarding the theory of multiple centers of Rambaud and Renault, a number of textbooks by authors such as Cunningham, Morris, and Keibel and Mall state that occasionally each lateral half of the fifth lumbar vertebra may ossify from two centers. Willis (1923, 1931) has indicated on what shaky foundations this assertion rests. It would seem to have been deduced from the finding of specimens showing separation of the neural arch, for no definite observations of the appearance of such double centers in foetal life have yet been reported.

pedicle and a portion of the body." In addition, these authors state that "in a foetus of ten to eleven weeks (length of column, seventy to eighty millimeters), the anterolateral and posterior centers have undergone fusion". Again, in résumé (page 76) they state that "each vertebra is composed, from the middle of the third month for some, and at the end of the third month for others, of: (1) a median center; (2) an accessory median center; (3) an anterolateral center; (4) a posterolateral center (these two last are already united to form the lateral arch); and (5) an intermediate lateral center".

The work of Rambaud and Renault, however, has been



### *Observations on Vertebral Ossification*

In order to check the existence of possible double centers for the neural arch, observations were carried out on ninety human foetuses, ranging from the sixth week of intra-uterine life to term. Sixty of these specimens were prepared according to the method of Skarda to reveal the ossific centers. This technique enables the observer to follow under the dissecting microscope the finest ramifications of the ossific process. The bone centers are preserved within the cartilaginous matrix, and the method possesses the great advantages that relations are maintained and that there is little danger of creating those artefacts of the delicate bone which so misled earlier investigators. Furthermore, centers which are so fine as to cast no shadow roentgenographically are readily revealed. The remaining specimens were examined by clearing in benzol or by dissection following fixation in formalin.

The findings in regard to the order and time of appearance of the various centers are essentially in agreement with those of Mall. Essentially each vertebra ossifies from three centers,—one for the body, rather complex in arrangement; and one, on either side, for the neural arch (Figs. 5 and 6).

Ossification of each half of the neural arch, as described by Willis, commences at the base of the articular process in, as far as can be judged, the immediate proximity of the isthmus (Fig. 7, *a*). This is preceded, as in all endochondral ossification elsewhere, by the invasion of vessels from



FIG. 6

Photograph ( $\times 10$ ) by oblique illumination of specimen cleared by Skarda's technique, showing lateral aspect of fifty-millimeter embryo with centers for neural arch. Note the position of the center for the neural arch in the fifth lumbar vertebra. The small center seen below the fifth rib shown is the proximal end of the twelfth rib. See anterior view of this specimen (Fig. 5).

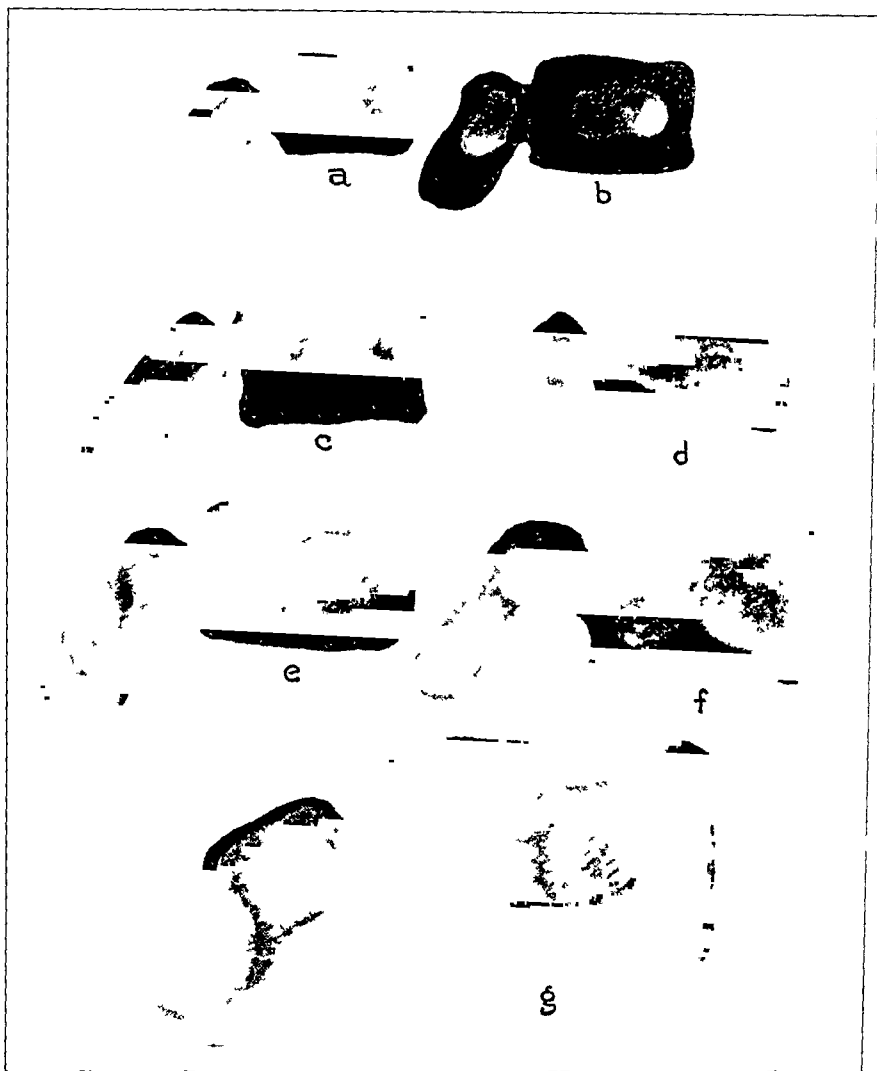


FIG 7

Different steps of ossification of body and neural arch For details see text

the laminar arteries. Thence the process spreads and expands dorsally and ventrally, the bony lamina being formed a little ahead of the pedicle (Fig. 7, *a* to *g*). As a result, the bony half arch remains for a considerable time somewhat constricted in the region of the isthmus, the point of initial bone formation (Fig. 7, *b* to *f*). The periphery of the isthmic region remains cartilaginous up to and after birth.

A double center for each half arch was not found in a single specimen either in the lumbar region or elsewhere. The complete absence of anomalous centers in a total of ninety foetal specimens examined is not without significance when taken in conjunction with the reports of Willis (1520 spines with seventy-nine isthmic defects), Congdon (200 spines with ten defects), Hasebe (125 spines with seven defects), Hayek (200 spines with six defects), Shore (fifty-six spines with five defects), and Schwegel (100

spines with four defects). Together, therefore, these authors found in about 2000 spines an incidence of separation of the neural arch in excess of 5 per cent. This is more significant as Willis, Hayek, and others have failed, in spite of deliberate search, to find a single example of such an arrangement in the foetal material which they have examined. If the lesion is congenital and if the true incidence is 5 per cent., failure to find a single example either of anomalous centers or of imperfect ossification in the prenatal period is significant. This is doubly so by virtue of the large sample and the homogeneity of incidence within the sample itself, on which the incidence of 5 per cent. of failure of fusion is based. We must, therefore, conclude that the admittedly attractive view which regards the defect as being due to failure of fusion of anomalous centers or to defects in ossification, depending as it does entirely upon presumptive evidence, is unacceptable for lack of positive findings.

Apart from developmental variation, the question as to whether the defect is the outcome of trauma has had much consideration. Disregarding the opinion of Lane that solution of the bone can occur from the presence of the superincumbent weight, there has been much opposition to the idea of fracture. Various arguments to account for non-union have been brought forward,—the absence of sharp and irregular edges, the absence of signs of repair, and, in a number of examples, the too close approximation of the fragments. The existence of unilateral examples is an insuperable difficulty in the minds of Willis and Shore and is, in their opinion, ample ground upon which to discard fracture as an etiological possibility. Trauma as a factor cannot, however, be lightly dismissed.

Observations made upon the author's series of ninety foetal specimens confirm the findings of Willis (1931) that the isthmic zone is an area of great potential weakness. As already pointed out, although ossification begins in juxtaposition to the isthmic region and spreads thence to pedicle and lamina, the isthmus itself consists very largely of cartilage until after birth, the bony connection between remaining somewhat narrowed. In addition, there are considerable differences in bone texture. The laminae early show well-marked trabeculation (Figs. 8 and 9) in the longitudinal axis, and the bone of the pedicles is more compact. The isthmic region, however, shows very little bone. Histological sections and injected material cleared by the Spalteholz technique show this area to be occupied by a relatively large lake of blood vessels, almost sinusoidal in character. The vessels supplying this plexus enter on both neural and external aspects, although those from the neural aspect are usually larger. The significance of these nutrient vessels in weakening the arch has been pointed out by Willis. However, the author cannot agree with Willis's inference that these two bony expansions on either side of the isthmus form two centers. The writer cannot follow his statement that "*there seemed to be an intermediate stage of calcification of cartilage prior to actual osteogenesis, and into this calcified cartilage the real bone centers developed following the blood vessels*". It is clear that in endochondral

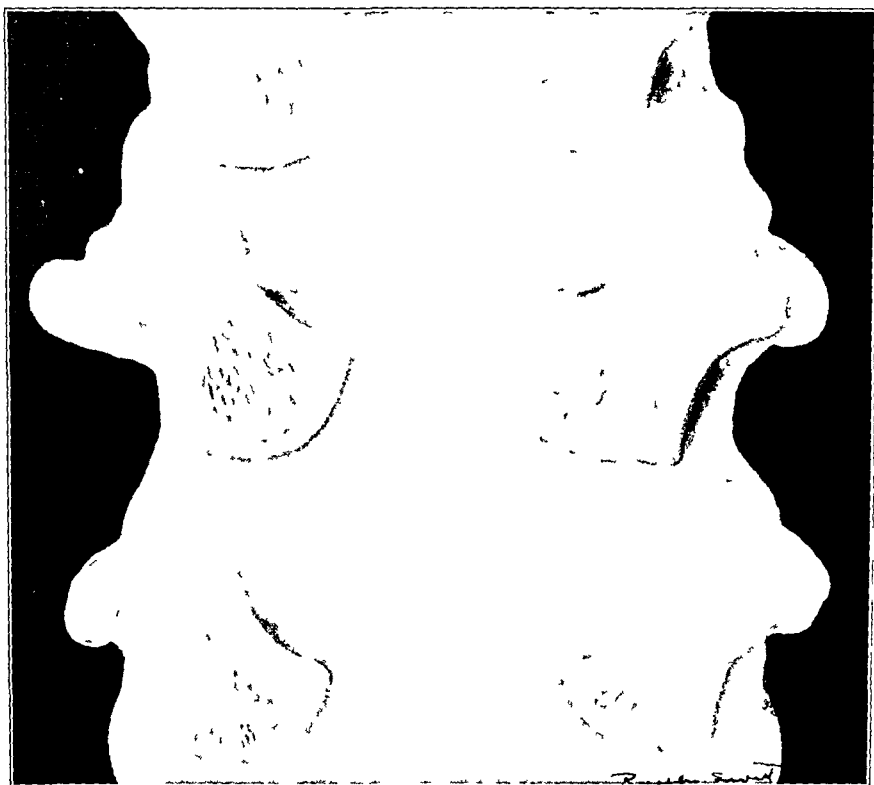


FIG. 8

Drawing of ossifying laminae of 146-millimeter foetus prepared by Skarda's technique. Trabeculation of the laminae is well shown with homogeneous border of advancing calcification. The narrowest and thinnest part of the ossified area is at the isthmus. At this time the isthmus is composed of a narrow core of bone surrounded by cartilage.

bone, vascular infiltration of the cartilage is always followed by calcification and, finally, by osteogenesis. If the author has interpreted his meaning correctly, Willis describes a stage in which two osteogenic centers occur in the half arch separated by calcified cartilage. The writer's observations in no way agree with this interpretation. Furthermore, they are not borne out by Willis's photomicrographs. This appearance is more apparent than real, due to the hourglass shape of the ossific center and the large central blood lake in the constricted portion.

### *Experimental Observations*

Experiments were carried out on stillborn children varying in age from eight months to term and on infant cadavera up to ten months post-natal. It was found that hyperflexion of the spine, often of very moderate degree and with little force, readily fractured the neural arch in the lower lumbar region. Such fractures, in the majority of instances, were bilateral, but unilateral fracture could be produced by combining flexion with lateral bending and some torsion. The production of such fractures in the lumbar region by hyperflexion is readily understandable in terms of

leverage, the greatest tensile force falling at the end of the lever at the junction between the fixed and relatively mobile portions of the spine.

In addition, it should be borne in mind that, of the movements of the lumbar column, flexion is far more restricted than extension. Virchow pointed out many years ago that in flexion the lumbar column simply straightens out, while extension increases the lumbar curve. By actual measurement, the movement of the lumbar column in flexion is scarcely 12 degrees from the perpendicular, whereas in extension it amounts to more than 25 degrees. It is apparent, therefore, that, if flexion is slightly forced, great leverage is exerted upon the neural arches with the vertebral bodies as fulera, which is resisted by ligaments and soft structures only. Such a force naturally has its maximum effect upon the lower lumbar neural arches, which fracture at their weakest part,—namely, the isthmus or pars interarticularis. Unilateral fracture is not unexpected, for the laminae have not yet fused. On examination, in known examples of separation of the arch, the fracture followed in very close fashion the direction of the defect. In addition, the fracture passed through material which was predominantly cartilaginous.

Attempts at hyperextending the spine completely failed to fracture the laminae. If the position was forced, tearing of the anterior longitudinal ligament and separation of the vertebral bodies ensued.

These findings greatly strengthen the traumatic theory of the genesis of spondyloschisis and rob this view of many of its objections. Such a force could be applied in flexion during delivery or shortly after birth. If the fracture occurred in early infancy or in childhood, it would account for the findings of union by fibrous tissue or cartilage, the development of a pseudarthrosis, such as has been reported in different specimens, the absence of healing, and unilaterality. There is much to be said for the suggestion of Brailsford that "spondylolisthesis and other conditions which narrow the pelvis lead to great difficulty in obstetrics, and the child is sometimes so forcibly pulled, crushed, twisted, or turned that the skull, ribs or limbs are broken or birth palsies produced. Therefore, while spondylolisthesis in the mother leads to difficulty in childbirth, difficulty in childbirth may lead to spondylolisthesis in the child."

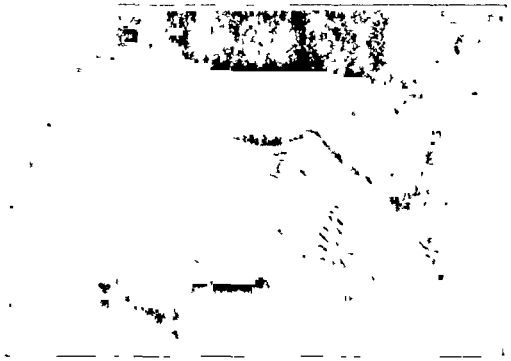


FIG. 9

Posterolateral (oblique) view of the fifth lumbar vertebra from a specimen of six months. Note the compactness of the bone formation in the lamina and pedicle with a junctional constricted zone of more or less structureless bone between. Ossification of the superior articular process is extending as a promontory from the pedicle side of the junctional area. The inferior articular process is forming in conjunction with the lamina.

## SUMMARY

In the three cases of spondylolisthesis which have been presented, roentgenographic evidence of progressive slipping of the fifth lumbar vertebra on the sacrum has been shown. It is suggested that trauma during delivery or shortly afterward may be the cause of this defect.

The author wishes to thank Dr. J. B. Saunders, Professor of Anatomy at the University of California, for his invaluable assistance and advice and for permission to review the University's collection of fetuses.

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## TUBERCULOSIS OF THE MANDIBLE

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Tuberculosis of the mandible is considered a rare disease. Before 1922, according to Chapotel, only fifty cases were recorded in the literature, and since that time reports on tuberculosis of this bone have been very infrequent. The following clinical study was prompted by the increasing number of mandibles affected by tuberculosis observed in this Clinic during the last two and one-half years.

In a period of seventeen and one-half years (January 1922 to June 1939), fourteen cases of tuberculosis of the mandible were observed in the Peiping Union Medical College Hospital. Of these, only one was seen before 1931, while eight cases were encountered within the last two and one-half years. This does not mean that the incidence of this condition is increasing rapidly. Rather, it suggests that, because of its rarity, tuberculosis of the mandible hitherto has not been considered regularly in the differential diagnosis of destructive osteomyelitic lesions of this bone. It is interesting to note that, among the fourteen cases observed, five were diagnosed clinically as tuberculosis and one was considered as probable tuberculosis, while chronic suppurative osteomyelitis was the clinical impression in the remaining eight cases. Roentgenographically, however, the diagnosis of tuberculosis was made in only three cases, probable tuberculosis in one case, and osteomyelitis in the remaining ten cases. In two cases of multiple lesions, involving both the mandible and the skull, the lesions of the skull were diagnosed roentgenographically as tuberculous, while those of the mandible were considered to be osteomyelitic. In 1934, Baranoff reported 185 cases recorded as osteomyelitis of the mandible and observed within a period of ten years (1922 to 1932) in the same Hospital. In view of our recent observations, the question may be raised as to whether, in some of the more than 50 per cent. of his cases that were so diagnosed but were not treated, tuberculosis might not have been the etiological agent.

Tuberculosis of the mandible apparently affects both sexes equally. In this series, eight patients were male and six were female. According to Chapotel, more than 60 per cent. of such lesions are seen in patients under fifteen years of age. The ages of our patients, at the time of admission, ranged from four to forty-eight years. In only one case did the patient's age fall within the first decade, whereas in the majority of the cases the ages fell within the second and third decades (six in the former and five in the latter), and in two cases, the ages were above forty years. The average age on admission was twenty-two and two-tenths years. In

ten out of the fourteen cases (71.4 per cent.), the disease was said to have existed for not more than six months. The shortest duration was one month, and the longest, two years. The right side of the mandible was affected almost twice as often as the left (the right in nine cases, the left in five).

Local injury is often blamed for the localization of a tuberculous lesion in a bone or a joint, but a distinct history of trauma in the cases in this series is lacking. Dental caries has been considered by many writers<sup>2, 7, 9, 10</sup> as playing a definite rôle. Caries of teeth was recorded in two of our cases, but, in both, the caries was not on the same side as the tuberculous lesion of the mandible. It was observed that the majority of our patients with tuberculosis of the mandible were poor, undernourished, and had associated pulmonary lesions.

The onset of the disease, as a rule, is very insidious. In some of our cases, the patients were unable to tell definitely when or how the disease had started. However, a great majority (eleven or 78.5 per cent.) gave a history of having had single or repeated attacks of so-called toothache prior to the development of a



FIG. 1-A

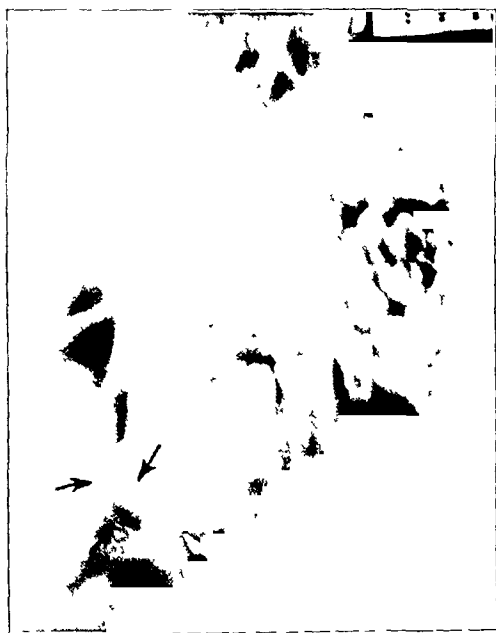


FIG. 1-B



FIG. 1-C

Tuberculosis of the mandible in a female (No. 44112), aged twelve years. Associated lesions: tuberculosis of lungs, skull, left elbow, right ankle, and metatarsals of left foot. Operation was not performed on the mandible, but tuberculosis of the skull was proved by smear and guinea-pig inoculation from pus aspirated from the abscess.

visible swelling of the jaw. Two patients gave no history of pain, and, in one case, the question of toothache was not mentioned in the record. In certain instances, the pain had been so mild that only after careful questioning did the patients recall that some kind of aching sensation had been present before the disease had fully developed. Some of the more intelligent patients characterized their "toothache" as a feeling of distention and pressure. In one case, however, the disease was said to have been preceded by typical acute attacks of toothache.

Local swelling (Fig. 1-A) was complained of by every patient. In many cases, it had appeared gradually, but in some it was comparatively acute and was accompanied by pain and tenderness. A typical acute inflammatory swelling was never observed. In some cases, the swelling extended from the pre-auricular area almost to the chin, and in others it involved a less extensive area along the body of the lower jaw. In the beginning, the swelling commonly was said to have been firm, usually not painful, and only occasionally slightly tender. In some cases, the swelling was said to have appeared and to have disappeared irregularly, but in all cases it gradually became softer and eventually ruptured spontaneously either into the oral cavity along the periodontal tissues, or outside along the inferior border of the lower jaw, or in the pre-auricular region, forming various numbers of sinuses (Figs. 2 and 3-A) from which small sequestra at times were discharged. In twelve cases, sinuses were found on the outside of the jaw, and, in the remaining two cases, periodontal sinuses were present. Six patients had both intra-oral and extra-oral sinuses.

Secondary infection usually was present, and purulent material escaped from the sinuses. When drainage was poor, there was more pain and tenderness. Generally there was little reaction of the tissues surrounding the sinuses. The scanty granulations looked pale, and the edges of the wounds sometimes appeared undermined. Healed wounds presented a contracted appearance, with scars adherent to the underlying bone. In those cases with intra-oral sinuses, the gingival tissues looked puffy, anaemic, and occasionally slightly ulcerated. The tooth or teeth in the area of the lesion occasionally became loose. Indeed, in one case, some of the teeth had become so loose that the patient had picked them out himself. Aside from a single case in which there were extensive ulcerative lesions involving the mucous membrane of the cheek, the gum, the palate, and the tonsillar region, due to an associated acute infection



Fig. 2

Tuberculosis of the right side of the mandible in a male (Out-Patient Department No. 402678), aged forty-two years. The lesion chiefly involves the periodontal tissues, and very little change of the mandible is demonstrable in the roentgenogram. Note the location of the sinus in the right cheek. Associated lesions: not determined.



FIG. 5

Tuberculosis of the mandible in a male (No. 65187), aged forty-eight years. Note the extensive lesion involving the ramus from the condyle to the angle of the mandible. The entire posterior portion of the ramus has sequestered and has been displaced downward to the level of the hyoid. Note also a semilunar lesion at the inferior border of the body of the mandible. Associated lesions: none. Lungs clinically negative.

*form*, in which the alveolar process is involved either by direct extension of the tuberculous gingival tissues or by way of a deep carious tooth. The



FIG. 6

Tuberculosis of the mandible in a female (Out-Patient Department No. 372382), aged fourteen years. Note the pathological fracture through the angle of the mandible. Associated lesions: tuberculosis of lungs, skull, ulna, metacarpals, and metatarsals.

common. In this series, they were observed in five cases, in each of which the lesion was situated in the ramus (Figs. 3-B, 5, 6, and 7). The lesion may involve the angle of the mandible (Figs. 1-B, 6, and 7) or the alveolar process of the body (Fig. 8). Occasionally, a cyst-like cavity may be noticed in the body of the mandible below the roots of the bicusps and the first molar tooth (Figs. 4 and 9). The outline of the cavity may be indistinct. In the cavity, faint bone shadows may be indicative of thin small sequestra. The cortex of the bone may be very slightly expanded over the cavity, but this expansion hardly reaches significant dimensions before spontaneous rupture takes place and a sinus is formed.

Chapotel described four clinical forms of tuberculosis of the mandible:

1. *The superficial or alveolar*



FIG. 7

Tuberculosis of the mandible in a female (No. 67490), aged sixteen years. Note the pathological fracture through the angle of the mandible. Associated lesions: tuberculosis of lungs.



FIG. 8

Tuberculosis of the mandible in a male (No. 50868), aged nineteen years. Associated lesions: tuberculosis of lungs and ribs.

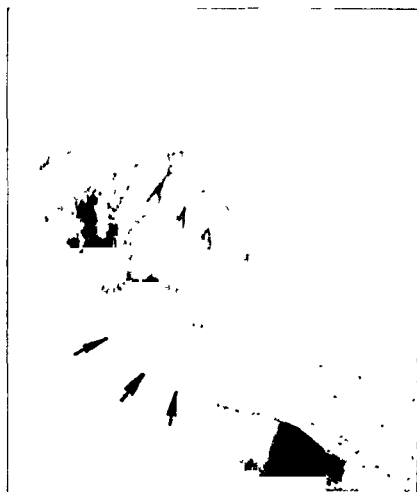


FIG. 9

Tuberculosis of the mandible in a male (No. 67492), aged twenty-one years. Note the cyst-like lesion in the body of the mandible, which is slightly expanded inferiorly, and the presence of sequestra in the cavity. Associated lesions: tuberculosis of lungs.

course is usually chronic, and necrosis of bone is progressive, with formation of abscesses and fistulae.

2. *The deep or central form*, in which the lesion involves the angle of the mandible. It is found, according to Chapotel, almost exclusively in children during the period of eruption of the molar teeth.

3. *The diffuse form*, characterized by progressive extensive necrosis of the mandible, which at times involves the temporomandibular articulation following a period of swelling and suppuration. Painless pathological fracture may occur. Severe general symptoms, accompanying a wide spread of tuberculosis affecting the liver, the lungs, the kidneys, and the meninges, are characteristic of the fatal aspect of this form.

4. *The acute osteomyelitic form*, in which, as the name implies, the sudden onset, the acute local and general manifestations, and the rapid course simulate those of an acute osteomyelitis of the mandible. This form is, however, very rarely observed.

Of the fourteen cases of this series, diagnosis was definitely established in twelve by pathological study of the tissues (Fig. 10). Multiple osseous lesions were present in each of the remaining two cases. In one, guinea-pig inoculation with pus obtained from the lesion of the skull was positive for tuberculosis, thus indirectly confirming the clinical diagnosis of tuberculosis of the mandible. In the other case, tuberculous lesions involving the radius, the spine, the elbow, and the skull, together with positive chest findings, furnished supportive evidence as to the nature of the co-existing lesion of the mandible.

As yet, no standard method has been described for the local treatment of tuberculosis of the mandible. Operative treatment usually consists



FIG. 10

Photomicrograph of a section of tissue removed from the mandible (No. 67490), showing tubercle formation.

in incision and drainage, sequestrectomy, and partial ostectomy. Seven patients were thus treated. Healing was obtained in two patients observed for periods of five months and two years respectively. Improvement was observed in four patients, of whom three have been under treatment for a relatively short time. One patient was definitely worse after the operation, because of a reactivated pulmonary lesion. Occasionally, improvement may be obtained following radical resection of the mandible in patients with extensive lesions,<sup>6</sup> but this procedure is hardly justifiable in the average case. In two instances, only loose teeth were extracted: in one of these a small sinus healed, but broke open again intermittently; while in the other, in which active pulmonary tuberculosis was present, the condition became worse. One patient, who showed little change in the mandible roentgenographically, but who had a small sinus near the third molar and an external sinus at the angle of the mandible, was treated with thymol, both externally and by mouth, for four and one-half months. Incision and drainage of an abscess of the jaw were performed later. The sinuses healed promptly and were observed to have remained healed when the patient was seen a year later in follow-up examination. Three patients were not treated because of their multiple skeletal and pulmonary lesions, and one patient disappeared from the Clinic.

#### COMMENT

The rarity of tuberculosis of the mandible is not purely accidental. Two factors may be responsible. First, the mucous membrane of the oral

an insidious onset with or without preceding attacks of "toothache" and accompanied by a discharging sinus, and if the roentgenograms show a varied extent of necrosis of bone without much evidence of involucrum, one must be on the lookout for a tuberculous lesion of the mandible. The simultaneous presence of a painless pathological fracture of the mandible and the coexistence of other tuberculous lesions, especially of the bones of the face and of the skull, make a diagnosis of tuberculosis of the mandible very likely.

The treatment of tuberculosis of the mandible has not yielded gratifying results in most cases. From the study of this series of cases, the author feels that general treatment of the patient should be the essential consideration. Tuberculosis of the bone, irrespective of its mode of infection, is an expression of a general disease as well as a local lesion. It is not logical, therefore, to expect a prompt cure of the local lesion of the mandible while the patient harbors tuberculous foci elsewhere in the body and the general health is far below par. In order to improve upon the results of the treatment of this lesion, it may be pertinent to suggest that those who reside in districts in which tuberculosis is prevalent should be tuberculosis-conscious whenever an osteomyelitic lesion of the mandible is dealt with, so that an early lesion may not be passed by unsuspected; and also that before, during, and after the treatment of the local lesion a general antituberculous regimen should be instituted.

#### SUMMARY AND CONCLUSIONS

Tuberculosis of the mandible, although heretofore considered to be rare, has been observed not infrequently. Of the fourteen cases reported in this paper, eight were seen within a period of two and one-half years. The majority of the patients belonged to the second and third decades of life. Swelling, discharging sinuses, and, occasionally, trismus of the jaw were the chief complaints. About 43 per cent. of the patients in this series had tuberculous lesions in other bones of the body, and tuberculosis of the skull was coexistent in 29 per cent. In ten of the cases in which the chest was studied roentgenographically, evidence of tuberculosis either in the lungs (eight cases) or in the pleura (two cases) was seen in 100 per cent. Pathogenically, it appears that the tuberculous infection of the mandible is almost always hematogenous, originating from a primary focus elsewhere in the body, most likely in the lungs, although the mandible may be involved from extension of a tuberculous lesion of the mucous membrane of the oral cavity or from infected gingivae about carious teeth. Rational therapy must emphasize general antituberculous measures in addition to local treatment of the tuberculous lesion of the mandible.

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# THE INTERPRETATION OF SCIATIC RADIATION AND THE SYNDROME OF LOW-BACK PAIN \*

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It should be anticipated that the great majority of cases of low-back strain are due to minor injuries to the soft tissues, but it is difficult to establish the pathological corollary of these lesions. They are transitory; the opportunities for biopsy are scarce; and, lastly, our pathological knowledge of the minor lesions of soft tissues is rather limited. On the other hand, if it is conceded that these lesions are essentially traumatic or at least mechanical in nature, then it would seem necessary only to identify the structures involved in order to apply the law of analogy in the interpretation of the complaint and the symptoms which present themselves.

All over the body, strain and tears of the tendinous and periosteal attachments of muscles manifest themselves by identical signs,—the distinct and sharply defined pressure point; a certain attitude of relief, involuntarily assumed to prevent further strain; and the tendency of the involved structures to respond favorably to immobilization. This is as true of the tennis elbow produced by lesion of the origin of the radial extensors of the wrist as it is of some lesions in the shoulder-joint capsule, which are due to tears or strain of the tendinous insertions. Likewise, all over the body the ligamentous structures respond to strain and stress in similar manner, except that the strict localization changes with the degree of depth and the accessibility of the structure to the palpating finger,—for example, strain of the deltoid ligaments of the ankle and of the collateral ligaments of the knee. The same is true of the lesions of the highly sensitive fascial structures, such as the iliotibial band; and, lastly, strain of the muscles, of traumatic or static nature, manifests itself all over the body by the same vague tenderness, muscle induration or contracture, and attitude of relief.

Therefore, in cases of low-back pain, it should not be difficult to recognize the precise structure involved. Indeed, the observer will soon find that there are several stereotype patterns of pressure or "trigger points":

1. The sacrospinalis syndrome (Fig. 1, 1), producing a pressure point at the posterior superior or inferior iliac spine.

2. The lumbosacral syndrome (Fig. 1, 2), with a pressure point at the lumbosacral junction.

3. The gluteal syndrome (Fig. 1, 3), producing a pressure point at the gluteus maximus insertion.

4. The transversosacral syndrome (Fig. 1, 4), with a pressure point at the transversosacral articulation in cases of sacralization of the fifth lumbar vertebra.

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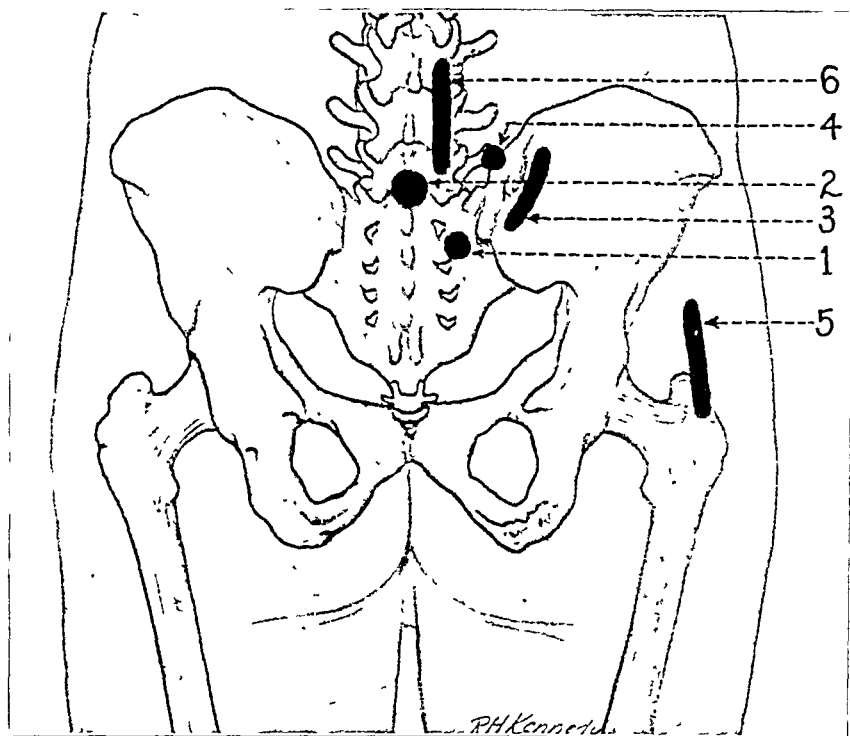


FIG. 1  
Grouping of "trigger points".

- |                            |                                   |
|----------------------------|-----------------------------------|
| 1: Sacrospinalis syndrome; | 4: Transversosacral syndrome;     |
| 2: Lumbosacral syndrome;   | 5: Tensor fasciae latae syndrome; |
| 3: Gluteal syndrome;       | 6: Myofascial syndrome.           |

5. The tensor fasciae latae syndrome (Fig. 1, 5), with the tender point at the lateral border of the fascia and iliotibial band and a positive Ober sign.

6. The myofascial syndrome (Fig. 1, 6), with vague tenderness along the sacrospinalis muscle and its fascial sheath.

The great obstacle in the diagnosis of low-back pain is the frequently associated sciatic radiation. Principally, the confusion is due to the general assumption that sciatic radiation must necessarily mean direct sciatic irritation either of the nerve trunk or of its component radicular elements. On the grounds of this assumption, sciatic radiation has been interpreted by various observers as a pressure phenomenon along the entire course of the nerve. Nevertheless, with the exception of one or two clearly defined situations, there is absolutely no anatomical proof that direct nerve pressure is responsible for the sciatic phenomenon.

#### DIAGNOSTIC GROUPS OF SCIATIC RADIATION

1. The exceptional situation in which there is proof of direct pressure upon the sciatic-nerve roots obtains when the lesion is in the spinal canal,—for example, tumor, herniated disc, or hypertrophied ligamentum

flavum. A high degree of exactness can be claimed for the diagnosis in this type of case. It is based on the high incidence of clinical neurological signs, the primary appearance of sciatic radiation, which is either simultaneous with or antecedent to the low-back signs, the high spinal-fluid protein, and the demonstration of a spinal block.

2. The interpretation of the sciatic radiation as the effect of radicular compression is much less well founded. In the group of congenital anomalies, the author believes that the claims of direct root compression are almost wholly lacking in proof. This applies to the assumption of a too-narrow intervertebral foramen; other congenital anomalies—such as tropism, laxity of the neural arch, spondylolisthesis, and sacralization—are, the author believes, only indirectly responsible for sciatic radiation, in that they facilitate and favor ligamentous and muscular strain, which give rise to the radiation in a manner to be considered later.

3. The possibility that arthritic proliferations about the intervertebral foramina and in the intervertebral canals may be responsible for direct compression of the sciatic roots cannot be denied, although proof of actual compression of the nerve in the foramen is still lacking. If the compression theory is accepted, it is strange that paraesthesia and signs of spinal irritation are not complained of in the sciatic radiation which follows low-back pain; yet such sensations are noted in the purely arthritic type. They may be referable to the *nervus sinuvertebralis*, described by Purkinje in 1845 and by von Luschka in 1850, which receives fibers from the sympathetic ganglion and supplies vessels and periosteum in the intervertebral canal. Still, paraesthesia and sensations of chill and heat, so often observed in the arthritic spine, are seldom seen in the sciatic radiation of the low-back pain.

If a true joint is formed between the fifth lumbar transverse process and the sacrum, there is a possibility of the development of arthritis in this transversosacral joint.

#### SCIATIC RADIATION OF PURELY REFLEX ORIGIN

It seems to the writer that this deadlock in the diagnosis of sciatic radiation cannot be overcome unless we break away from considering direct mechanical irritation of the sciatic nerve or its component roots as the only possibility of the production of sciatic radiation in connection with low-back pain. It is the author's contention that there is a large group of cases of low-back pain in which the sciatic radiation has nothing whatever to do with direct irritation either of the nerve trunk or of its roots, and that it is purely a reflex phenomenon, which follows and does not precede the low-back pain. Furthermore, it is the writer's belief that the afferent branch of the reflex arc is furnished by the sensory fibers supplying the injured muscular, ligamentous, and aponeurotic structures and that the connection with the sciatic nerve is made not lower than the spinal ganglia and possibly in the spinal cord. To prove the reflex character of this radiation, it is first of all necessary to show that anatomically

the territory of the involved soft structures of the low back is entirely separate from the origin of the sciatic nerve.

From the anatomical point of view, the soft structures of the back are entirely and exclusively supplied by the posterior primary division. This division supplies the motor and sensory nerves to the long muscles of the back, their aponeuroses and periosteal insertions, and their muscle sheaths and superficial ligaments, and thereby forms one physiological unit. In addition to this, the tendinous attachment to the gluteus maximus as well as to the tensor fasciae latae, the long posterior sacro-iliac ligaments, the ligamentum sacrospinous, the ligamentum sacrotuberous, and, indirectly, the piriformis, with its anatomical relation to the ligamentum sacrotuberous, are all supplied by the posterior primary division (Poirier, Cunningham, Ingebrigtsen).

Also, the deeper ligamentous structures of the sacro-iliac junction, the iliolumbar ligament, and the transversosacral joint in the case of sacralization are supplied either totally or in part by the posterior primary division in lumbothoracic lesions (Pitkin and Pheasant).

The proof which establishes the causal connection between the localized musculo-aponeurotic lesion and the sciatic radiation has been worked out recently by the writer and Dr. J. V. Luck. It rests upon the fact that, upon irritation of the so-called trigger point, the sciatic radiation is exaggerated; while, upon injection of this point with novocain, the local pain, as well as the sciatic radiation, at once disappears and the leg signs become negative. We hold that this test shows conclusively the connection between the local lesion in the back and the sciatic radiation, and that, because no anatomical connection between the peripheral sensory nerves exists in the two territories, it must necessarily be assumed that the sciatic pain in these cases is purely a reflex phenomenon.

Of all groups of cases of low-back pain with sciatic radiation, this is one of the largest, comprising not less than 30 per cent. of the cases, according to our statistics. It is more than likely that the group is considerably larger, because there are many cases in which circumscribed pressure pain does not develop (for instance, the myositic group, in which the sciatic radiation is likewise a reflex phenomenon); yet, because of the absence of a circumscribed point, the novocain test cannot be carried out. Within this large group, several subdivisions may be distinguished, according to the localization of the pressure point:

### *The Sacrospinalis Syndrome*

This is the most frequent type. The pressure point is well localized inside the posterior superior or inferior spine and within the sacral triangle; the leg signs are positive.

B. S., female, twenty-one years old. The acute onset of low-back pain, centered medial to the right posterior superior spine, was followed by right sciatic radiation; the leg signs were positive. No scoliosis was present. Novocain injection of the trigger point abolished radiation for two hours, and the leg signs disappeared. The patient was cured by support. She was under observation for two years.

### *The Lumbosacral Syndrome*

There is tenderness in the lumbosacral joint, the pressure point becoming more definite upon backward bending, when the sacrospinalis muscle is relaxed. This syndrome indicates a lesion in the lumbosacral ligamentous system.

E. V. H., male, thirty-five years of age. The patient gave a history of pain of insidious onset and of six months' duration. Tenderness was present over the left lumbosacral joint, with left sciatic radiation. There was no scoliosis. Novocain injection of the left lumbosacral joint gave complete relief for one hour, and the leg signs became negative. There was a recurrence of symptoms under conservative treatment. Relief was ultimately obtained by lumbosacral fusion.

### *The Supraspinous-Ligament and Intraspinous-Ligament Syndrome*

This syndrome is very similar to the lumbosacral syndrome. The pressure point is localized in the supraspinous ligaments between the fourth and fifth lumbar vertebrae or between the fifth lumbar vertebra and the sacrum, and becomes more definite upon hyperextension. Radiation is not infrequently bilateral, and the leg signs are positive. In these cases, if immobilization does not suffice, resection of the spinous processes may sometimes be necessary to relieve the impingement.

M. M., male, thirty-four years of age. In this case, the pain, caused by a fall, was of sudden onset and of eleven years' duration. Tenderness was noted over the supraspinous ligament between the fourth and fifth lumbar vertebrae, with bilateral radiation. Hyperextension of the lumbar spine was painful; the leg signs were positive on the right. Novocain injection gave complete relief of local and radiating pain for several hours. Conservative treatment failed. Complete relief followed excision of the impinging spinous processes of the fourth and fifth lumbar vertebrae.

### *The Gluteal Myofascial Syndrome*

Tenderness is localized lateral to the posterior inferior spine, with radiation down the posterior part of the thigh; the leg signs are markedly positive on that side. The condition is due to strain or injury along the line of origin of the gluteus maximus.

F. W., male, thirty-five years old. The pain was of sudden onset and of four months' duration. Tenderness lateral to the left posterior superior spine was noted. The leg signs were positive on the left. There was body shift to the right, with left sciatic radiation. Injection of three cubic centimeters of 1-per-cent. novocain into the trigger point abolished local and radiating pain temporarily; the leg signs disappeared. Pain was relieved by conservative treatment. The patient was observed for one year.

V. R., female, forty-three years old. The pain was of insidious onset and of ten months' duration. There was tenderness lateral to the right posterior superior spine and at the right mid-gluteal region, with sciatic radiation on the right. The leg signs were positive. Novocain injection relieved local and sciatic pain for two hours; the leg signs disappeared. Conservative treatment afforded no relief. Stripping of the right posterior superior spine (release of myofascial tension) gave complete relief. The patient was observed for one year.

### *The Transversosacral Syndrome*

This is produced by arthritis or ligamentous strain. It is seen in sacralization of the transverse process. The tenderness is directly over

the transversosacral joint, with radiation down the posterior thigh; the leg signs are positive. Resection of the articulation is often necessary, if immobilization does not give relief.

W. A., male, eighteen years old. The pain was of insidious onset and of six years' duration. Tenderness was present over the left transversosacral joint and the sacro-sciatic notch, with sciatic radiation on the left. The leg signs were positive. There was body shift to the right, with sacralization of the fifth lumbar vertebra on the left. Novocain injection into the left transversosacral joint relieved local and sciatic pain for one hour; the leg signs disappeared. Conservative treatment was unsuccessful, while transversectomy gave relief. The patient was observed for two years.

N. M., female, eighteen years of age. The pain was of insidious onset and of six years' duration. Tenderness medial to the left posterior superior spine, with left sciatic radiation, was noted. The leg signs were negative. Roentgenographic examination showed sacralization of the fifth lumbar vertebra on the left. Injection of three cubic centimeters of novocain into the transversosacral joint abolished local and radiating pain. After conservative treatment had failed, fusion of the transversosacral joint afforded complete relief. The patient was observed for seven months.

### *The Tensor Fasciae Latae Syndrome*

It is in cases of this type that the Ober operation is performed; the tenderness is over the lateral aspect of the posterior superior spine and extends down the gluteal region over the posterior border of the iliotibial band as far as the trochanter. In many of these cases the Ober sign is positive, but it is significant only if associated with tenderness of the iliotibial band. The strain is in the entire aponeurotic structure which covers the gluteus maximus and blends with the iliotibial band. Therefore, release of this strain at any point very often breaks the reflex arc, as in the Ober operation.

R. McK., male, thirty-six years old. The patient gave a history of pain of sudden onset. Tenderness lateral to the posterior superior spine was noted on the left, with left sciatic radiation (secondary). The leg signs and the Ober sign were positive. Novocain injection lateral to the left posterior superior spine gave complete relief of local and radiating pain, and the leg signs disappeared. Tensor fasciotomy gave complete relief for one month, followed by a recurrence. Another novocain injection gave complete temporary relief of both local and radiating pain, proving the seat of pain to be in the musculo-aponeurotic system of the back. Traction, crutches, and a corset afforded complete relief. The patient was observed for fifteen months.

In this case, the failure of the fasciotomy was due to the fact that the tensor fasciae latae symptom was only part of the complex. The strain extended farther back into the thoracolumbar fasciae. Prolonged immobilization accomplished the result.

### CONCLUSIONS

It seems that, if one recognizes the reflex character in a large number of cases of low-back pain with sciatic radiation, the entire aspect of the prognosis and treatment changes. It becomes evident that the sciatic radiation stands or falls with the success or failure of immobilizing treatment for the local back lesion,—whether this immobilizing treatment consists in merely external immobilization by plaster cast or ex-

ternal appliance; or in internal fixation, if external immobilization is inadequate; or even in the elimination of a painful joint by resection, as in the transversosacral syndrome; or in the relief of the tension which cannot be accomplished by immobilization, as in the operation of Ober.

Since the publication of the former paper on the novocain diagnostic test, Dr. Luck and the author have information on the end results of immobilization treatment of low-back pain with sciatic radiation. In 100 consecutive cases apparently suitable for the test, the test was positive in sixty-nine and negative in thirty-one. Of the sixty-nine cases in which the test was positive, the end results were good in fifty-eight, or 84 per cent., and poor in eleven, or 16 per cent. Of the thirty-one cases in which the test was negative, the end results were good in six, or 20 per cent., and poor in twenty-five, or 80 per cent. The type of immobilization ranged from bed rest with traction, casts, and braces to fasciotomy, transversectomy, and fusion.

We feel that, in a considerable proportion of the cases of low-back pain with radiation, the recognition of the reflex character is essential for rational diagnosis and treatment of the condition.

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# TREATMENT OF CONGENITAL TORTICOLLIS

BY ROBERT SOEUR, M.D., BRUSSELS, BELGIUM

## GENERAL CONSIDERATIONS

Treatment of congenital torticollis should have three objectives: (1) correction of the contracture, (2) avoidance of visible scars, and (3) reduction to the minimum of the operative risk.

### *Correction of the Contracture*

It is generally agreed that the treatment of congenital torticollis is essentially surgical. Many operative techniques have been recommended, the chief differences between them being the choice of the incision, the length of the immobilization period, and the postoperative care. Among the methods which have been advocated are: low subcutaneous tenotomy; low open tenotomy in which the incision, several centimeters in length, follows the clavicle and the upper border of the sternum; and open tenotomy at the mid-portion of the sternocleidomastoid or at the upper attachment of the muscle near the mastoid process. The main feature of all these procedures is that the muscle is attacked at a single point,—unipolar tenotomy. Because these methods have failed to prevent the formation of aponeurotic bands, which are forcibly stretched when the head is placed in a position of hypercorrection, other more radical operations, such as partial or total excision of the muscle, have been described.

To obviate these difficulties, the author uses a bipolar tenotomy after the manner of Putti, which consists in a subcutaneous division of the sternocleidomastoid at its lower insertion, followed by an open tenotomy near the mastoid process. The bands which remain after section of the lower insertion automatically disappear when the sternocleidomastoid is severed at the level of its upper attachment.

A long plaster cast, extending from the iliac crests to the top of the head, is applied and maintained for a period of two months. It is the author's belief that if immobilization is not maintained for such a period the operation will result in failure. An incontestable advantage of prolonged immobilization is the fact that postoperative physiotherapy is not required; none of the author's patients have received massage, exercises, Schanz collars, or leather braces. After removal of the cast, the writer has never seen a case of contracture of the healthy muscle on the opposite side. Moreover, atrophy and loss of function of the tenotomized muscle need not be feared. In fact, the operation effects a lengthening of the muscle at its attachments; fibrous callus, true tendon, is formed at the site of the musculotendinous portion.

### *Avoidance of Visible Scars*

A large incision at the level of the clavicle, of the sternum, or of the mid-portion of the muscle often causes a visible scar. As the skin is under



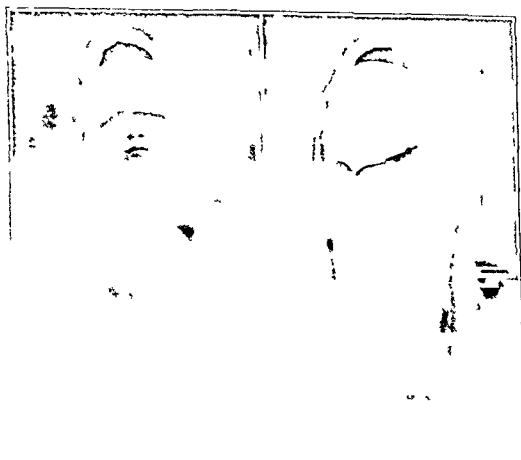
tension when the neck is kept in a position of hypercorrection, often the line of incision becomes hard and keloid. The combination of the inferior subcutaneous tenotomy and the superior open tenotomy never produces a visible scar at the lower part of the neck; the scar which is located near the mastoid process is hidden by the ear and the hair. Thus the only advantage of the subcutaneous operation (absence of scar) may be realized and at the same time a complete operation may be performed.

### *Reduction to the Minimum of the Operative Risk*

The author often performs the operation with the patient under local anaesthesia,—novocain infiltration of the two operative areas. In the case of a very young or an extremely timid child, general anaesthesia should be used; the operation never lasts more than fifteen minutes. At this point should be considered the technique of immobilization and the rapidity of its execution. The Schanz collar, which is easy to apply, is, in the author's opinion, inadequate. A plaster cast is indispensable, but the application of a good cast under general anaesthesia requires one hour; this prolongs the period of anaesthesia and needlessly increases the operative risk. Moreover, orthopaedic tables are poorly adapted to the modeling of minerva casts. Although some surgeons postpone for a day or two the preparation of the cast, this is not satisfactory, for by that time the patient will have become restive. These facts have led the author to adopt Ducroquet's method of preparing the cast before operation.

### PREPARATION OF PLASTER CAST

With the patient in the upright position, a light, well-molded thoracic jacket, previously padded with cotton, is applied from the iliac crests to the sternal region in front and the seventh cervical vertebra in back. Formerly, it was the author's practice to cover the well shoulder, but at present he prefers to leave both shoulders free. A plaster helmet is then applied; this helmet is surmounted by a crest made of light wood and covered with plaster, which is to be used as a handle. The apparatus is trimmed, so that the operative fields are left well exposed at the level of the lower insertions of the muscle and at the level of the occipitomastoid attachment.



from iliac  
with handle.  
free.



FIG. 2

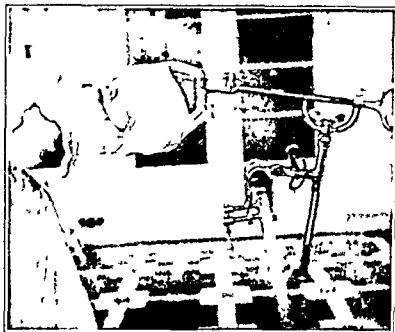


FIG. 3

Two patients after bipolar tenotomy under local anaesthesia and completion of cast. The special apparatus which supports the upper part of the body can be seen. Note the inclination of the table and the sandbags on the chair.

#### ANAESTHETIZATION

When the plaster is dry, the patient is placed on the operating table. A non-sterile assistant sits near the head of the table and, by means of the handle on the helmet, turns the patient's head as directed by the surgeon. If a general anaesthetic is required, this assistant administers it. Whenever possible, the author performs the operation with the patient under local anaesthesia. The skin and both extremities of the muscle are infiltrated with from ten to fifteen cubic centimeters of a 1-per-cent. novocain solution. If the patient is very young or timid, ethyl chloride and ether are given.

#### BIPOLAR TENOTOMY

The operating table is slightly inclined, so that the patient's feet are lower than the head. The management of the operative fields is delicate, since it is necessary to work through a window in the plaster.

A small incision, a few millimeters in length, is made along the superior border of the sternum or of the clavicle, depending upon whether the contracture is sternal or clavicular. If both heads of the muscle are contracted, the incision is made between the two attachments. With his left thumb and index finger, the operator pinches the tendon and makes it project under the skin in such a manner as to separate it from the vessels. In his right hand he holds a small scalpel, which he passes under the tendon, so that it is divided from back to front. A click is produced, and the contracture of the muscle disappears. Eventually, through the same incision and according to the same technique, the lower insertion of the muscle is cut. The



FIG. 4

When the operation is performed under local anaesthesia, the patient is allowed up on the same evening. The patient can walk and play very

immediate correction obtained by this low tenotomy is not sufficient. As a matter of fact, if the patient's head is inclined toward the well shoulder, tension of the muscle, especially in the upper part of the neck, will be noted. One should refrain from blindly exploring the deep tissues with the scalpel in an effort to free the aponeurotic bands. A compressed dressing placed in the wound is sufficient to check the relatively abundant amount of blood which escapes. The assistant exerts digital pressure until the end of the operation.

The mastoid region is next considered. A fingerbreadth below it and directly under the superior insertion of the sternocleidomastoid, which is easily located, a horizontal incision, slightly concave toward the top and four centimeters in length, is made. With Kocher's forceps, each bundle of muscle tissue, either from the mastoid process or from the occipital



FIG. 5-A

FIG. 5-B

Right congenital torticollis. Patient ten years old at operation in August 1936.



FIG. 5-C

FIG. 5-D

Nearly three years after operation, May 1939. The contracture has disappeared; the shoulders are horizontal; there is no visible scar; and the asymmetry of the face has disappeared.



FIG. 6-A

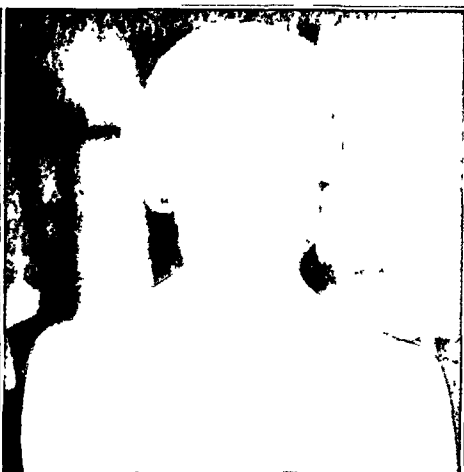


FIG. 6-B

Left congenital torticollis. Patient eleven years old at operation in July 1936. Note the marked deformity of the shoulders.

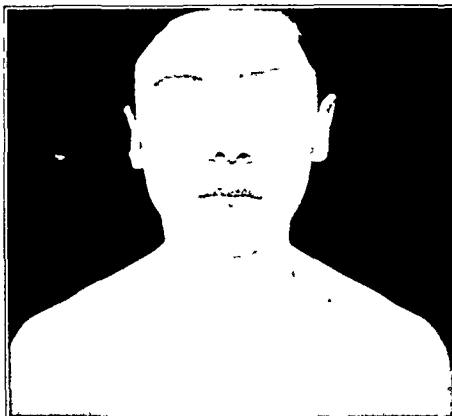


FIG. 6-C



FIG. 6-D

Three years after operation. Note symmetry of neck, shoulders, and face. There is no visible scar.



FIG. 6-E



FIG. 6-F

Showing perfect function of the neck

region is lifted up and severed with the scalpel under visual control. In the course of these manoeuvres, one should not forget that the facial nerve emerges in front of the mastoid process and under the parotid gland and should at no time be uncovered or, above all, cut.

The deformity is then hypercorrected by inclination of the head toward the well side and rotation of the face toward the involved side. It is thus seen that the neck is absolutely flat, the muscle being entirely flabby. The skin is closed by three or four linen sutures.

#### COMPLETION OF CAST

The patient is moved toward the head of the table, to which are strapped the legs, the abdomen, and the chest (the two latter regions are encased in plaster). The shoulders, the neck, and the head extend beyond the table. Formerly, the anaesthetist supported the head by grasping the handle on the helmet, and maintained it in a position of hypercorrection,—inclination toward the well side and rotation toward the involved side, without flexion or extension. The author now employs as a substitute for the assistant's hand a special piece of apparatus, which mechanically holds the patient's head in place. This support is clamped to the back of a chair and to it is attached a hook, which grasps the handle on the helmet. This hook can be moved in three planes and fixed in the desired position.

The patient's shoulders should be in an absolutely horizontal position; therefore, the arms are symmetrically extended the length of the body, and the hands are strapped to the table (Figs. 2 and 3). After a sterile dressing has been applied, the helmet and the jacket are joined together by plaster bandages; the portion covering the chin should be well molded. When this has been completed, only the patient's eyes, nose, and mouth are free.

#### POSTOPERATIVE CARE

If the operation is done under local anaesthesia, the child is allowed up the same evening; otherwise he is kept in bed until the second or the third day after operation. He regains his equilibrium after a few minutes and walks easily. He is discharged from the hospital at the end of from three to five days, and is allowed to resume his normal activities. The cast is worn for two months. The stitches are not taken out until the cast has been removed. For several days after the removal of the cast, the child holds the head in the hypercorrected position, and his equilibrium is disturbed, but the normal state is rapidly resumed, and the head becomes straight. The secondary deformities are spontaneously corrected in time.

This procedure does not involve, either before operation or after removal of the cast, the prescription of massage or of the various exercises described in the classic textbooks.

#### ANALYSIS OF CASES

From 1933 to 1939, the author has personally employed the technique described in forty cases of congenital torticollis. Since the results

TABLE I  
SUMMARY OF FIRST TWENTY CASES OF CONGENITAL TORTICOLLIS TREATED

Case	Sex	Age (Years)	Tendinous Attachment	Side	Postoperative Follow-Up	Remarks
Mar.	Male	7	Sternal	Right	1 year	
Boq.	Male	6	Sternal and clavicular	Left	1 year, 5 months	
Kor.	Female	14	Sternal and clavicular	Left	1 year	
Ker.	Female	8	Sternal	Right	1 year, 7 months	
Ca.	Female	6	Sternal and clavicular	Right		Not followed
Poi.	Male	10	Sternal	Left	2 years, 5 months	Forceps used at birth
Ver.	Female	2	Clavicular	Left	2 years, 6 months	
Evr.	Female	10	Clavicular	Right	2 years, 9 months	
Gra.	Male	11	Sternal and clavicular	Left	2 years, 10 months	
Win.	Male	9	Clavicular	Right	1 year, 5 months	Mentally deficient
Lac.	Male	15	Sternal and clavicular	Left	3 years, 2 months	
Len.	Male	13	Sternal	Left	1 year, 4 months	Previous operation by another surgeon
Tol.	Male	3	Sternal	Right	3 years, 7 months	
Dut.	Male	4	Sternal	Right	1 year, 9 months	
Dur.	Female	5	Sternal and clavicular	Left	1 year, 8 months	
Yer.	Male	7	Clavicular	Right	1 year	Mentally deficient
Gil.	Female	8	Sternal and clavicular	Right	2 years	
Pla.	Female	3	Sternal and clavicular	Left	3 years	
Tam.	Male	10	Sternal	Left	4 years, 2 months	
Mer.	Male	18	Sternal and clavicular	Left	4 years, 5 months	Previous operation by another surgeon

can be truly evaluated only after postoperative follow-up of a year or more, the data contained in this paper are from the first twenty cases treated from 1933 to April 1938.

*Sex:* There were twelve males and eight females.

*Age:* The youngest patient was two years of age, and the oldest was eighteen. Most of the patients were between the ages of six and twelve, but three were fourteen or over. In general, immediate operation is advised. In the case of a newborn infant, however, operation is delayed

until the child is able to walk. The operation is never performed on children under two years of age.

*History:* Two of the children were mentally deficient. In only one case was there a history of difficult labor and the use of forceps. Two patients had been operated upon by other surgeons, and the deviation had recurred.

*Clinical Aspect:* In seven cases the contracture was sternal; in four cases it was clavicular; and in nine cases both insertions of the muscle were involved. Roentgenographic examination in all of the cases was negative for spina bifida. The three patients over fourteen years of age had marked secondary deformities,—scoliosis dorsalis and cervicalis and asymmetry of the face, shoulder girdle, and chest.

*Operation:* Bipolar tenotomy (low subcutaneous tenotomy combined with high open tenotomy) was performed in all cases. In seventeen cases general anaesthesia was employed, and in three cases local infiltration was used. In the most recent cases, not included in this series, this proportion has been reversed, and the majority of the patients have been operated upon under local anaesthesia.

*Postoperative Follow-Up:* All of the patients were photographed before operation, and all except one were again photographed one year or more after operation. In three cases the follow-up period was one year; in six, between one and two years; in five, between two and three years; in three, between three and four years; and in two, more than four years. It is, of course, impossible to publish photographs of all of the twenty patients, but the author wishes to emphasize the fact that the photographs which are shown (Figs. 5-A through 6-F) have not been chosen from those illustrating the better results; they show the ordinary type of result which may be obtained by this operation.

*Results:* In nineteen cases, comparison of the preoperative and postoperative photographs shows excellent results: in each case the head is perfectly straight, the shoulders are even, and there is no visible scar on the neck. In the one case in which a postoperative photograph could not be obtained, a report from the visiting nurse states that the result is excellent. The secondary deformities in patients less than fourteen years of age have been spontaneously corrected with growth. In the three patients over fourteen years of age, the secondary deformities have been little influenced by the treatment.

#### CONCLUSIONS

In patients under fourteen years of age, the treatment of congenital torticollis by bipolar tenotomy and immobilization in plaster in a position of hypercorrection for two months results in complete and permanent cure. In patients over fourteen years of age, correction of secondary deformities is not to be expected, but the improvement in the position of the head, neck, and shoulders is so striking that operation is definitely indicated.

TETANUS AND LESIONS OF THE SPINE IN CHILDHOOD \*

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*From the Children's Hospital, Los Angeles, and the Medical School of the University of Southern California*

Tetanus has been one of the dread diseases throughout all time because of the suffering and high mortality with which it is associated. At the Children's Hospital, Los Angeles, during the past eighteen years, the mortality rate has dropped from 80 to 8 per cent. Of the surviving patients who have been examined, 69 per cent. showed lesions in the thoracic spine. It is felt that these two facts are worthy of examination.

The cases of twenty-eight patients, ranging from two to eleven years of age, seen in the wards of the Hospital since 1921, were studied for this report. Except for three cases of tetanus in very young infants, they represent the cases of tetanus seen in the Children's Hospital during the years 1921-1939.

All children were put in darkened, quiet rooms, and were protected from unnecessary external stimuli. For the purpose of evaluating treatment, the cases have been divided into two groups: those observed from 1921 through 1932 have been designated as Group I; those seen from 1933 through 1938 have been classified as Group II. (See Table I.)

TABLE I  
DISTRIBUTION AND MORTALITY IN TWENTY-EIGHT CASES OF TETANUS

Group	Years	No. of Cases	No. of Deaths	Mortality (Per Cent.)
I	1921-1932	15	12	80
II	1933-1938	13	1	8

Obviously this small number of cases cannot be accorded great statistical significance, but no one can deny that a definite improvement in mortality has been achieved in the past six years. It will be impossible to prove directly what factors have accounted for the increasing rate of recovery. However, the authors believe that they can clearly show that, in a high percentage of the cases, death was due to the treatment given; the cause for the improved mortality figures then suggests itself.

\* Read at the Annual Meeting of the American Academy of Orthopaedic Surgeons, Memphis, Tennessee, on January 18, 1939.



## GROUP I

During the years 1921 to 1933 the plan of treatment called for débridement and the injection of tetanus antitoxin in large amounts locally, intramuscularly, intravenously, and intrathecally. Very little sedation was given. Morphine, chloral hydrate, and magnesium sulphate were used with great caution. The patients in this group received from 15,000 to 100,000 units of antitoxin. The patients who were given the smaller doses failed to receive larger amounts only because of their early death.

Of the twelve deaths, eleven occurred within fourteen hours of the institution of treatment. Many of these patients had relatively mild cases, showing only a slow progression of symptoms up to the time of entry into the Hospital. In every instance, however, the reaction to treatment was the same. Within a few hours after the first treatment, the temperature rose to between 104 and 108; the pulse rate ranged from 140 to 200 per minute; and the respiration was rapid and irregular. The patient became stuporous and soon expired without convulsions. In other words, the disease picture was changed from one of tetanus, with relatively low temperature and pulse rate and clear sensorium, to a condition resembling the several diseases which are accompanied by signs of grave bulbar involvement. In the twelfth case in which the patient died, a temperature of 107 and a pulse rate of 180 developed shortly after the first treatment. The patient remained practically moribund (in spite of continued therapy) and died forty-eight hours after treatment was instituted. Each of the three patients who recovered showed a similar but less serious reaction. After short periods of grave uncertainty, the reaction subsided suddenly, but the tetanus improved more slowly. One of these patients had such severe reactions following each intraspinal injection of antitoxin that the outcome was each time questionable.

What was the cause of the sudden critical change in each of these patients? It was obviously some factor in the therapy, for the majority of the patients were in excellent condition when treatment was started. Within from three to fourteen hours eleven of the fifteen were dead! The remainder suffered severe reactions. Every one of these patients had as part of the first treatment either intravenous or intrathecal injection of serum, or both.

The five cases in which the spinal fluid was studied some hours after the intrathecal injection showed spinal-fluid cell counts of from 800 to 4200, with from 80 to 100 per cent. polymorphonuclear leukocytes. The cell count in each instance had been normal at the time when the tetanus antitoxin was given. Autopsies were done on four of the patients who died suddenly, and in each instance showed marked medullary and cerebral oedema and mild to moderate inflammatory changes. Thus it appears that the hypersensitive central nervous system of the patient with tetanus cannot withstand the added insult of a sterile meningitis or increasing intracranial pressure, and twelve of the fifteen patients died.

Three of the patients who died suddenly after the commencement of treatment had intravenous but no intrathecal injection of serum. In none of these instances was the incubation period of the disease less than one week; in every case of previously normal temperature and pulse rate there was a dramatic rise to "bulbar heights". Although it could not be proved, it was the authors' feeling in retrospect that a serum reaction had caused cerebral oedema and consequent death.

#### GROUP II

When one considers the thirteen cases seen from the beginning of 1933 to the present time, one finds an interesting situation. The one death occurred three hours after the first administration of 20,000 units of anti-toxin intravenously. In the last twelve consecutive cases the patients recovered. In eight of these twelve cases *no* serum was injected intrathecally; in the remaining four cases severe reactions followed the administration of serum intraspinally, but somehow the patients managed to survive a few critical hours. The temperature and pulse rate then fell rapidly, although tetanic activity continued. The authors could not help but feel that these dramatic elevations and subsequent rapid falls of temperature and pulse rate were entirely dissociated from the course of the tetanus. Although symptoms of tetanus had been present for a variable period of time, the reactions always occurred after treatment, and subsided long before the tendency to severe tetanic convulsions had disappeared. Two of the surviving patients who had had intravenous but no intrathecal injection of serum showed similar severe reactions, so it is impossible to ascribe all of these "bulbar crises" to sterile meningitis. In one of these latter cases, when death seemed imminent, it was decided to give hypertonic sucrose intravenously in the belief that the reaction was due to cerebral oedema. A dramatic improvement followed within a few hours. Most interesting and significant of all, perhaps, is the fact that the four surviving patients who received only local and intramuscular injections of serum were, with one exception, the only patients who did not have a frightening reaction following the commencement of treatment.

In this group every patient received large doses of sedatives. Amytal, avertin, and, more recently, seconal were most commonly used.

#### DISCUSSION

One does not need to resort to mathematical analysis to appreciate that between 1921 and 1933 something was done to the patients that precipitated critical reactions and death. Between 1933 and 1938 similar severe, but fortunately not fatal, reactions were seen. In every instance they followed either intrathecal or intravenous administration of anti-toxin. Needless to say, all patients were tested for horse-serum sensitivity. Are we then to discontinue the intrathecal administration of tetanus antitoxin in juvenile tetanus? Emphatically yes! It has no theoretical or valid experimental advantage over the other routes of

administration, and, because of the severe reactions (sterile meningitis, cerebral oedema, and death) which follow its use, it is safe to state that it is a frequent cause of death in children so treated.

What of the intravenous use of serum? Here the answer is not so clear. Admittedly, it is highly desirable to have antitoxin circulating in the blood stream as soon as possible after the diagnosis of tetanus is made. In recent studies on the blood levels of pneumococcus antitoxin, given intramuscularly and intravenously, it has been shown that there is a lag in titer of from twenty-four to thirty-six hours when the serum is given intramuscularly instead of intravenously.<sup>1</sup> Probably then, in spite of untoward reactions, serum should be given intravenously in severe cases. If, as has been conjectured, the sudden grave reactions are due to cerebral oedema as a result of serum reaction, adrenalin should prevent them. It is strongly recommended, therefore, that adrenalin be given in conjunction with the introduction of any serum into a vein.

Small doses of serum should be injected about the infecting wounds prior to their débridement. The intramuscular administration of serum provides a continuous, if relatively slow, supply of antitoxin to the blood stream. Although many of the patients in the authors' series received more, it is felt that a total of from 30,000 to 50,000 units of antitoxin should prove adequate in practically any case of juvenile tetanus.

The authors are convinced that sedation plays a tremendously important rôle in the outcome of a case of tetanus. If, from the moment the child enters the admitting room of a hospital, he can be spared both the agony and the exhaustion of repeated severe convulsions, his chances of recovery will be enhanced greatly. The ideal sedative is one of low toxicity and rapid absorption, with an anticonvulsive effect. Preferably it should not inhibit gag and cough reflexes. Effectiveness, when administered parenterally or by rectum, is an added asset. Countless drugs have been used to attain this. Amytal and avertin have been found particularly valuable. Occasionally paraldehyde serves well. In three of their most recent cases the authors have used seconal by rectum, with very gratifying results. Excellent relaxation has been achieved without loss of consciousness or protractive reflexes. In spite of the relatively short duration of its action, it does not need to be repeated any more frequently than the other barbiturates; even a short while after receiving a large dose (from one and one-half to three grains), the child can be roused to take food and fluids. It has often been said that in severe tetanus one is uncomfortably wedged between the likelihood of death from convulsions and the possibility of death from the tremendous doses of sedatives that are necessary.

With the increasing recovery rate, there has also been a marked increase in the number of patients showing vertebral deformities. The possibility of preventing at least some of these by early and vigorous sedation naturally suggests itself.

It must be apparent that the authors' attitude toward the treatment

of tetanus is the direct antithesis of that of the workers who recommend tremendous doses of serum and very little sedation. Probably the lowest mortality rate that has been published for a large (and, therefore, significant) number of cases comes from a clinic which advocates huge doses of serum. The Los Angeles County Hospital reduced the mortality from 50 to 14.6 per cent. during a period in which heroic doses of serum and little sedation were given.<sup>1</sup> How can one reconcile the authors' views with such figures? It may be suggested that factors other than an increase in serum dosage may have played a part in reducing the mortality in that Hospital. More important, probably, is the fact that a child may react differently to intrathecal and intravenous injection of serum than does an adult. It is not inconceivable that a moderate amount of medullary oedema in a child may cause more grave and lethal symptoms than it would in an adult. Certainly the smaller subarachnoid space in a child allows less room for swelling. The type of death that followed intravenous and intrathecal administration of serum in the children in the authors' series differed in no respect from the sudden death, due to cerebral oedema, which accompanies virulent streptococcic infections in children.<sup>2</sup> The latter type of death is rarely seen in adults.

The second problem of convalescent tetanus—namely, spinal lesions—may be best appreciated by a roentgenographic study.

Reexamination of nine out of thirteen patients who had tetanus in childhood

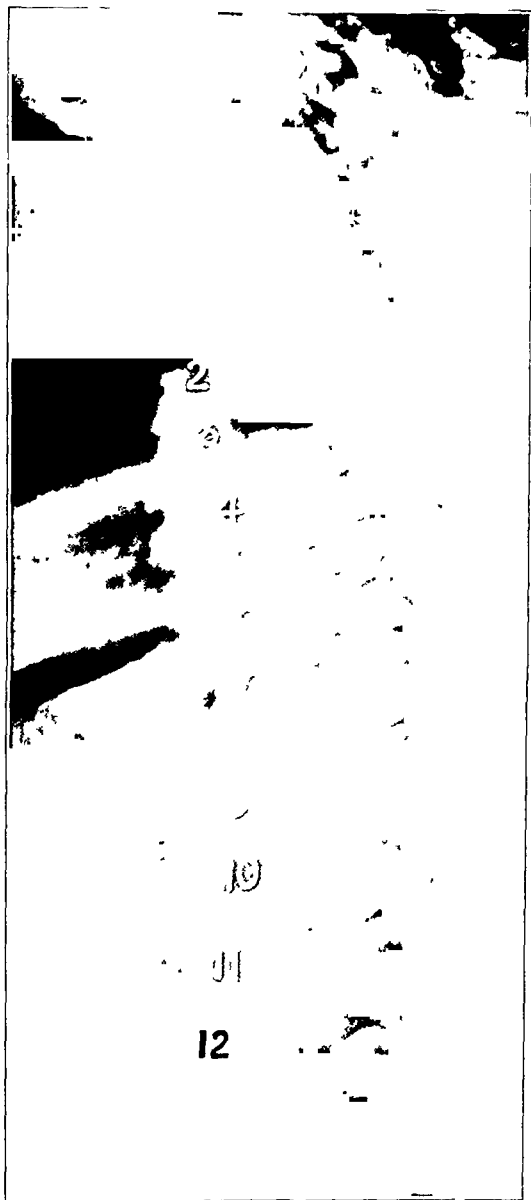


FIG. 1

Roentgenogram of patient No. 38-3598 showing a vertical compression and slight wedging of the fifth, sixth, seventh, and eighth thoracic vertebrae.

TABLE II  
ANALYSIS OF THE CASES OF NINE PATIENTS WHO HAD TETANUS IN CHILDHOOD

Case No.	Sex	Age (Years)	Treatment	Reaction Following Injection	Observation Period	Roentgenographic Findings
33-948	Female	10	Injection of 180,000 units of tetanus antitoxin	Severe	5 years	Wedging of 5th and 6th thoracic vertebrae, with flattened area over spinous processes from 5th to 6th.
34-1867	Male	5½	Intrathecal and intramuscular injection of 100,000 units of tetanus antitoxin	Severe	4 years	Wedging of 7th thoracic vertebra. (Orthopaedic examination negative.)
35-1496	Male	4	Intramuscular injection of 100,000 units of tetanus antitoxin	None	3 years	Wedging of 4th, 5th, and 6th thoracic vertebrae. (Orthopaedic examination showed flattened segments over 5th, 6th, and 7th thoracic vertebrae.)
37-2469	Male	11	Intrathecal, intravenous, and local injection of 200,000 units of tetanus antitoxin	Moderate	7 months	Wedging of 5th thoracic vertebra. (Orthopaedic examination showed flattened area in 5th, 6th, and 7th thoracic vertebrae. Slight segmental motion in affected area.)
37-3902	Female	12	Intravenous and intrathecal injection of 120,000 units of tetanus antitoxin Plaster jackets for 11 months	Severe	6 months	Flattening of 5th, 6th, and 7th thoracic vertebrae and wedging of 8th and 9th thoracic vertebrae. (Orthopaedic examination showed flattened area on flexion.)
38-1396	Male	9	Intramuscular injection of 90,000 units of tetanus antitoxin	None	Convalescence	Wedging of 5th, 6th, and 7th thoracic vertebrae. (Orthopaedic examination showed flattening in the mid-thoracic area.)
38-2273	Female	7½	Intravenous and intrathecal injection of 190,000 units of tetanus antitoxin	Severe *	Convalescence	Wedging and crushing of 4th, 5th, 6th, 7th, 8th, and 9th thoracic vertebrae. (Orthopaedic examination showed flattened area from 3rd thoracic to 1st lumbar vertebra, with limitation of anterior and lateral motion.)
38-3598	Female	4	Intramuscular and local injection of 85,000 units of tetanus antitoxin	None	Convalescence	Compression of 5th, 6th, 7th, and 8th thoracic vertebrae.
38-3440	Male	5	Intravenous injection of 20,000 units of tetanus antitoxin	Severe †	2 months	Wedging of 5th, 6th, 7th, and 8th thoracic vertebrae. (Orthopaedic examination negative.)

\* With tenderness over thoracic spine on second day.

† With severe tetanic convulsions.

showed compression of thoracic vertebrae without demonstrable fracture lines. One vertebra was involved in two cases; two vertebrae, in one case; three vertebrae, in two cases; four vertebrae, in two cases; five vertebrae, in one case; and six vertebrae, in one case. The fifth thoracic vertebra was involved in eight cases; the sixth thoracic vertebra, in seven cases; the seventh thoracic vertebra, in six cases; the eighth thoracic vertebra in four cases; the fourth thoracic vertebra, in two cases; and the ninth thoracic vertebra, in two cases. In those cases showing the least involvement, the compression was limited to the anterior portion of the vertebral body. Where there was more severe involvement, the entire vertebral body was compressed from above downward. Most of the affected bodies were wedge-shaped. Where involvement was most severe, the density of the compressed bodies was increased. The intervertebral spaces were unchanged. The upper and lower borders of the affected bodies were smooth and straight, except in the most severe instances, where they were slightly concave in lateral projection. In some instances the compression reduced the height of the body to less than half the normal. The dimensions of the affected vertebrae in the frontal and the median planes were normal. There was no erosion of the pedicles or demonstrable enlargement of the spinal canal. There was no demonstrable destructive lesion or cold-abscess shadow. In cases of most severe involvement, there was a gentle posterior curvature of the spine in the affected region. There was no demineralization of the vertebrae. The involvement centered about the fifth and sixth thoracic segments, extend-

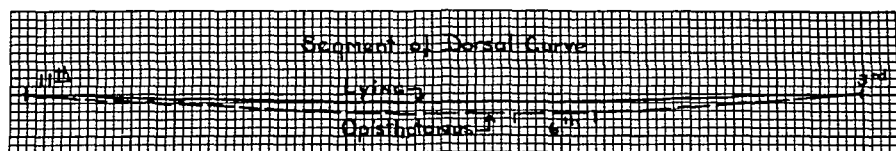


FIG. 2

Tracing of anterior border of thoracic vertebrae from the third vertebra to the eleventh in a normal individual lying supine and in the opisthotonic position, showing an increase in the dorsal curve in the hyperextended position.

ing as high as the fourth and as low as the ninth, thus differing in location from kyphosis dorsalis juvenilis in which the changes are most severe in the eighth and ninth thoracic vertebrae and are almost always limited to the lower half of the thoracic spine. The reduction in height of the affected vertebrae may be greater than in kyphosis dorsalis juvenilis. No other bone changes were demonstrable in any of the cases.

Based upon measurements of roentgenograms of the thoracic spine of several hundred infants and children, the authors believe that it is normal for each segment of the thoracic spine proceeding downward to be slightly greater in height than, or at least equal in height to, the segment above. This is in accordance with statements of anatomists generally. One investigator, however, in measuring the spinal segments of 102 per-

sons between the ages of eighteen and eighty-seven, found each caudal vertebra higher than the one above it, but the sixth thoracic segment he reported to be one millimeter lower than the fifth thoracic segment. His work applied to adults in whom postural changes may be effective in decreasing the height of the sixth thoracic vertebra.

#### DIFFERENTIAL DIAGNOSIS

In the differential diagnosis all the causes of collapse or shortening of vertebrae must be considered.

*Fracture* of the vertebral bodies, as well as of other bones, has been described as occurring in adults following the convulsions of tetanus. In the authors' series of nine cases of spinal deformity, following tetanus occurring in childhood, there was only compression. The line of fracture is seldom definite; the diagnosis rests upon deformity of outline and alterations in cancellous structure. Rarely is there callus. A compression fracture may vary from a slight break in the anterior or lateral margins of a body to a complete collapse of a portion of a body, usually the upper anterior portion. A comminuted fracture reveals extensive shattering of the vertebra. An old fracture shows osteophyte formation. The intervertebral disc above the fracture may be reduced in height, with concavity of the upper surface of the affected vertebra, sometimes with a definite shadow of herniation of the nucleus pulposus. So-called Kummell's disease is a vertebral fracture not recognized by the roentgen ray until collapse of the body occurs some time after the injury.

*Tuberculosis of the spine*, chiefly a disease of childhood, shows an irregular destruction of one or more vertebral bodies, followed by their collapse and the disappearance of the affected intervertebral disc. A fusiform shadow about the diseased area, usually best demonstrated in anteroposterior projection, results from the development of a perivertebral abscess, which may increase to a considerable size and may persist for years; this area may gradually become calcified during the process of healing. Thinning of the intervertebral discs may be the earliest sign of disease.

*Malignant lesions* of the vertebrae, either primary or metastatic, may occur at any age, but are most frequently observed in adults past middle age. The primary focus is often evident. In later stages there is an angular deformity. A giant-cell tumor shows characteristic trabeculation, often extending into the processes. In the case of a sarcoma the appearance varies from complete localized destruction of the affected body in the rapidly developing growth to a mottled structure in the slowly growing fibrous type, which is indistinguishable from metastatic growth. A malignant lymphoma produces a blurring of outline and a mottled appearance, while Ewing's sarcoma causes destruction; yet both are radiosensitive. A myeloma is soft and produces rarefied lesions with multiple trabeculae, and gradual compression of the affected bodies is to be expected. Radiation may relieve the pain. A hypernephroma is a

destructive lesion without distinguishing characteristics. Metastatic carcinoma occurs rarely. A hemangioma shows a reduction of bone density with parallel vertical lines extending through the body. It is somewhat benign, but causes severe pain; radiation produces symptomatic cure.

*Osteomyelitis* causes irregular rarefaction and new-bone formation. Rare in childhood, it has not been reported in infancy.

*Coccidiosis*, *actinomycosis*, or *blastomycosis* produce irregular areas of destruction, usually in several bodies, but without collapse. Chronic perivertebral abscesses accompany these lesions, and the responsible organism may be isolated in the discharge from the sinuses.

*Lucs* seldom involves the spine. Charcot's lesion does not occur in the joints of the thoracic region.

*Typhoid fever* causes localized areas of rarefaction near the corners of vertebral bodies, with local thinning of the adjacent discs and the subsequent development of a heavy bony bridge about the focus or disc. A common occurrence is the complete obliteration of the cartilage and fusion of the adjoining vertebrae, with no evidence of disease remaining in or about the bodies.

*Osteoporosis and metabolic disturbances*—the rare forms of hunger, traumatic, or senile porosis of the spine—may present flattening of the vertebrae. The texture is porotic. Herniation of the nucleus pulposus is common. There is wedging, as well as an increase in the posterior curvature of the spine. The superior and inferior vertebral borders are concave,—the so-called "fish" spine. The entire vertebral disc becomes thickened and enlarged, usually due to increased fluid content, and this expansion brings about pressure on the bodies, with resulting concave formation at both inferior and superior borders.

In *hyperfunction of the parathyroid glands*, in which there is a disturbance in calcium metabolism, there is usually a wide-spread demineralization involving all of the spine and other skeletal structures. In addition, there will be one or more vertebral bodies, more especially at the thoracic level, where there is uniform shortening of the height of the body with all other dimensions normal. A similar compression of a vertebral body may be observed in cases of disturbed lipid metabolism in young patients without uniform demineralization of other bones.

*Microspondylia* is an aplasia of the entire vertebra. The vertical diameter, as well as the transverse and median diameters, is lessened.

*Platyspondylia* has its genesis in a failure or a delay in the fusion of the lateral halves of the vertical anlage at its membranous stage of embryonic development, and manifests itself in three distinct types. Type I is characterized by an increase in width and a decrease in height of the vertebra, and posterior spina bifida. The adjacent vertebral discs are usually increased in height, and the condition is most common at the fourth and fifth lumbar segments. Type II is usually localized at the cervical and cervicothoracic regions, often associated with spinal anomalies of differen-



tiation, form, and number, with congenital maldevelopment of the ribs, elevated scapulae, and the short-neck syndrome. The affected vertebral bodies show an increase in their transverse diameters and a decrease in their vertical diameters, with an associated increase in thickness of the discs. Type III is usually localized, but it is rarely generalized. The outstanding symptom, noted in infancy, is an unusual flexibility of the spine of such marked degree that the patient cannot stand without support. Sitting, the infant presents a long posterior curve and a forward inclination of the body, because of inability to support the head and trunk. In anteroposterior reontgenograms all the vertebral segments are abnormally widened, their vertical diameters are lessened by one-half to one-third of the normal height, and their superior and inferior outlines are concave. The intervertebral discs are increased in height. Lateral projection shows only the disproportion in the vertical diameters of the discs and bodies. In the localized form the general effect is a fusiform widening of the spine.

*Osteochondritis, epiphysitis, or kyphosis dorsalis juvenilis* may involve one or more vertebrae during the first few years of life. There is irregularity of the vertebral outlines, with flattening and wedging of the vertebrae, followed by the stage of restitution in which the vertebral outlines appear dense and sclerosed with deformity. The intervertebral spaces are widened. There is an imbalance between the static demands and the static capacity, which is most likely to occur during the first and second periods of rapid growth of the spine. Involvement of the centrum of the vertebrae occurs in the first six or seven years of life. The superior and inferior vertebral epiphyses are affected during the ages of from nine to twenty-one. The involvement is usually most severe in the eighth or ninth thoracic vertebra and is almost always limited to the lower half of the thoracic spine. The changes in the vertebral bodies are confined to the superior and inferior surfaces. The typical early change is notching of the anterosuperior and antero-inferior corners of the bodies, producing a step-like appearance. The superior and inferior surfaces then become irregular, and prolapse of the nucleus pulposus into the body may occur. Collapse of the vertebral body progresses, giving rise to wedging. The anterior vertical height of the body, however, is never less than one-half the posterior height. Usually several vertebrae are involved.

*Extradural cysts of the spinal cord* reveal enlargement of the spinal canal and erosion of the thoracic pedicles, in addition to the vertebral-body deformities characteristic of *kyphosis dorsalis juvenilis*.

In *foetal chondrodystrophy* there is a widening of the vertebral bodies, with distinguishing irregularities of outline and of ossification.

*Osteochondrodystrophy*, an allied type of dwarfism, in which the patients do not attain a bone age of more than twelve or fifteen years, shows a generalized decrease in height of the vertebral bodies, associated with a relative increase in height of the discs. The bodies are of various sizes and shapes, the most common outline in lateral projection being

irregularly ovoid and narrowest in front. The lime content is well maintained, and the detailed structure approaches the normal.

### SYMPTOMS

What are the symptoms referable to tetanic injury of the spine? Subjectively, none of the patients in this series have complained of pain or fatigue. Objectively, there are three observations to be made: (1) There is absence both of local tenderness and of muscle spasm; (2) motions of the affected segment are slightly restricted; (3) the affected area is marked by flattening rather than by kyphosis. The junction of each end of the flattened area with the normal spine appears slightly angulated. These changes are not striking.

How may we explain these phenomena? Roberg<sup>3</sup> first called the attention of the English-reading world to this deformity in 1937 and offered an explanation of its occurrence. He states: "The opinion that contraction of the spinal extensors alone could lead to an increase in the normal thoracic anterior concavity between the cervical and lumbar anterior convexities is contradicted by the fact that normal physiological contraction of the back muscles bends the entire spine backward . . . ." He, therefore, goes on the assumption that the dorsal curve is flattened in the opisthotonic position. Is this assumption correct? The authors believe that it is not, for Cunningham<sup>1</sup> shows a roentgenogram of an acrobat whose body is bent so that his head and heels touch, yet the dorsal convexity of the thoracic spine is preserved. Again a roentgenogram of a normal person lying supine and in the opisthotonic position shows an increased dorsal convexity in the abnormal position. The authors are led, therefore, to have serious doubts as to the theory which Roberg propounds, which is based on what they believe they have demonstrated to be a false premise.

It is to be observed further that, with heavy sedation, the assumption of the opisthotonic position is relatively uncommon; a generalized rigidity of the musculature of the torso persists, but waxes and wanes irregularly.

A much simpler explanation of the condition than that proposed by Roberg may be offered. It is axiomatic that any muscle contraction tends to approximate the ends of the muscles along an axial line. If, then, there is a spasm of the entire musculature of the torso, the tendency would be to approximate occiput and pelvis by an increase in the normal spinal curves. This being the case, it is apparent that the greatest force would be exerted on the bodies of the thoracic vertebrae, especially those nearest the apex of the curve, and on the pedicles and facets of the cervical and lumbar spine.

It is the authors' conception that a vertebral body, like a block of wood, breaks down under repeated blows. One can conceive a convulsion severe enough to fracture a vertebral body, and one can imagine that many minor tetanic convulsions would hammer the mid-thoracic bodies

until the whole structure crushed down within itself, giving the picture described.

Assuming that this conception is correct, what shall be said of treatment? By the time anything can be done remedially for the patient, repair has occurred, and the deformity remains. As we find the condition practically symptomless, treatment has been found useless.

#### CONCLUSIONS

1. Small doses of serum are theoretically adequate.
2. No intrathecal injection of serum should be given in juvenile tetanus.
3. If serum is injected intravenously, it should be accompanied by adrenalin.
4. Sedatives are life-saving in juvenile tetanus, and may prove of value in preventing vertebral deformities.
5. In about 70 per cent. of juvenile patients who recover, compression of one or more vertebrae near the apex of the dorsal curve occurs.
6. Treatment of the spinal lesion is futile.

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## EPIPHYSITIS OF THE SPINE \*

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This paper is a presentation of the variations in the clinical and roentgenographic appearance of epiphysitis of the spine in seventy-five patients during the course of the disease, with end-result data in twenty-seven.<sup>14, 15, 17</sup>

In all of these patients the diagnosis of spinal epiphysitis was confirmed by competent roentgenographic examination. There were fifty females and twenty-five males.<sup>2</sup> The average age when first seen was 13.3 years for girls and 16.4 years for boys. The youngest girl was nine years of age, and the youngest boy was eight and one-half years of age. Twenty-three patients had not reached puberty. There was a history of a similar spinal lesion in other members of the family in fourteen instances. In one family there were three children, all of whom showed a kyphos with changes in roentgenograms consistent with epiphysitis, and the father had a definite kyphos. In another family a brother and sister had this lesion.<sup>13</sup>

A history of definite trauma to the spine, preceding the onset of symptoms, was obtained in nine patients.<sup>10</sup> All of the patients in the series showed faulty posture, which was probably of long duration. Often it was the faulty posture which made the patient seek treatment.<sup>7</sup> Scoliosis and associated spinal deformities were observed in twenty-two patients. Multiple epiphyseal lesions in various parts of the body were found in three.<sup>1</sup> Very rapid growth was noted in twenty-five. Obesity was found in fifteen. Nothing of etiological significance could be obtained in these histories in relation to trauma, infections, nutrition, or endocrine disturbances.

Laboratory studies upon these patients gave normal findings only.<sup>3</sup> Repeated basal metabolic tests upon eight patients were within normal limits. Other studies for endocrine dysfunction showed negative results. Blood titration for deficiency of vitamin A and vitamin C showed no deficiency in six patients. Measurement of the serum calcium and phosphorus in eleven patients revealed normal values. A determination of the blood phosphatase in four patients in whom the disease was in the early stage gave normal readings.

The diagnosis could not be made with assurance upon clinical findings alone (Fig. 1). A similar deformity was constantly found in cases of extremely faulty posture. While stiffness of the spine and a rounded kyphos (Fig. 2) were almost constant features, the other clinical signs varied according to the severity and the duration of the lesion. Pain at the region of the kyphos was a common early symptom; it was present in thirty-six out of fifty patients who sought treatment during the early stages of the disease, and disappeared usually after a few months. In two patients

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roentgenographic examination showed the disease without the presence of a kyphos. Kyphosis later developed in these patients. Roentgenographic examination was the only certain means of confirming the diagnosis (Table I). By this means, early diagnosis could be made and treatment could be instituted when there was still the possibility of preventing any permanent deformity.

We do not know how long the disease is present before changes are evident roentgenographically, but we have been able to trace certain changes in the roentgenographic appearance with the progression of the disease to a fixed, probably healed stage. In comparison with the clinical course, we feel that it is helpful to divide the disease into three stages, according to the roentgenographic appearance,—a stage of onset or early stage, a healing stage, and a healed stage.<sup>16</sup> Healing apparently took place when the epiphyses united to the vertebral body, and the disease gradually progressed to fixed spinal deformity of varying degree.

The spinal lesion involved a large number of vertebrae in all of the children observed, with the exception of three, in whom it was limited to one or two vertebrae. In sixty instances the thoracic spine showed the lesion; in two it was found only in the lumbar spine.<sup>8</sup> In thirteen patients it involved both the thoracic and the lumbar regions of the spinal column.

The most constant change was irregularity of the upper and lower surfaces of the vertebrae, particularly at their anterior margins. This was accompanied by irregularity in epiphyseal calcification.<sup>6</sup> Instead of the normal, regular, triangular, expanding, opaque areas, there were irregular,

TABLE I  
ROENTGENOGRAPHIC FINDINGS

	Roentgenographic Examinations				
	Original (Cases)	After 1 Year (Cases)	After 2 Years (Cases)	After 3 Years (Cases)	Over 4 Years (Cases)
Irregularity of surfaces of vertebrae.	64	9	4	4	9
Fragmentation of epiphyses . . . . .	44	3	1		
Wedging of vertebrae . . . . .	41	9	4	4	6
Herniation into vertebrae (Schmorl's islands) . . . . .	21	5		1	5
Decalcification . . . . .	8				
Step-like indentation on anterior margin of vertebrae . . . . .	10	4	3		1
Biconcave vertebrae . . . . .	3	1	2		
Biconvex vertebrae . . . . .	1				
Trapezoid vertebrae . . . . .	2	1			
Narrowing of intervertebral disc . . .	1				

frayed or spotty regions of calcification in the epiphyses, so that the epiphyses appeared to be fragmented. This appearance (Fig. 3) was present in forty-four patients. In nine patients this appearance persisted into adult life.

With these changes there was a slowly progressive wedging of the vertebral body, the posterior margin being wider than the anterior margin (Fig. 4). Vertebral decalcification was an inconstant early finding, being present in eight patients only. In these patients it was no longer apparent in roentgenograms taken one year later. In ten patients there was a marked step-like indentation of the anterior vertebral margin (Fig. 6).<sup>9</sup>

In twenty-one patients there were areas of decreased density (Fig. 5), usually called Schmorl's islands, in the upper and lower portions of the vertebral body, continuing to the intervertebral disc. These varied in diameter between five-tenths of a centimeter and two centimeters. One or several of the vertebrae might be involved. These areas did not seem to partake in the deformity, nor were the vertebrae more misshapen when they were present. The intervertebral discs about them appeared to be of normal thickness and did not suggest an extensive herniation of the nucleus pulposus, the commonly given explanation for the appearance of these islands. They were present in the first roentgenograms and during the time our patients were followed.



FIG. 1

Eighteen-year-old boy with deformity of four years' duration. There is a marked thoracic kyphosis with stiffness of the thoracic spine. Roentgenograms show involvement of the spine from the fifth thoracic vertebra to the second lumbar vertebra.

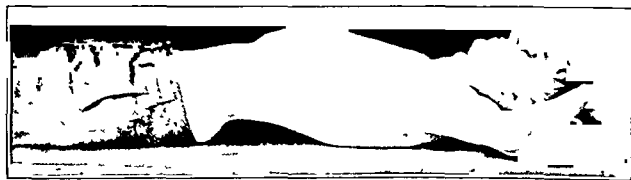


FIG. 2

The same patient as in Fig. 1, lying supine. The lumbar spine is markedly hyperextended, and the head does not reach the table.



FIG. 3

Roentgenogram of a twelve-year-old girl with mild kyphosis and stiffness of the thoracic spine. There is extensive irregularity on the upper and lower surfaces of the vertebral bodies from the seventh thoracic vertebra to the eleventh. The epiphyses are calcified irregularly.



FIG. 4

Lateral roentgenogram of the mid-thoracic spine of a man, twenty-seven years of age. There is anterior wedging, especially of the sixth thoracic vertebra.



FIG. 5

Lateral roentgenogram of a man of twenty. There is irregularity of the upper and lower surfaces of the vertebral bodies. There are areas of decreased density extending into the bodies of the third, fourth, and fifth lumbar vertebrae.

As the disease progressed to the healing stage, coincident with postural compensation for the kyphos there was no longer any further progression of vertebral deformity, and there was a tendency for the superior and inferior surfaces of the vertebrae to become smooth. Irregularity in epiphyseal calcification was less evident. The step-like indentation and the Schmorl's islands did not change in their appearance.

In the healed stage, complete calcification of the epiphysis and union with the vertebral body were noted. After this time, changes in the vertebrae remained practically constant throughout life. The final roentgenograms, if considered alone, often gave a confusing picture. In three adult patients they suggested a healed compression fracture. In these cases the diagnosis was dependent upon the history of early development of stiffness and of the kyphos

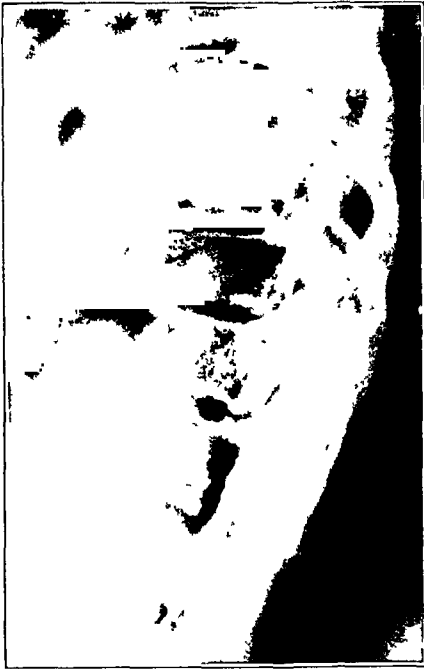


FIG. 6

Anterior wedging of the vertebral bodies with exaggerated step-like indentation at the anterior margins of the vertebral bodies in the lower thoracic region.



FIG. 7

Lateral roentgenogram of the same patient as in Fig. 3, taken five years later. The upper and lower vertebral surfaces are fairly smooth. The epiphyses appear to be fully calcified. There is practically no wedging of the vertebral bodies. Physical examination shows no kyphos and normal flexibility in the spine. The patient was treated with exercises and a plaster jacket with the spine in extension.

and a negative history for injury. The apparent fragmentation in the epiphyseal plate persisted after the epiphysis was completely calcified and united to the vertebral body, as was seen in a twenty-year-old man. A number of vertebrae, sometimes not adjoining, showed flattening and an anterior projection of the upper anterior margin,<sup>11</sup> which persisted throughout the period of study. If a previous roentgenogram had not been available, such changes might have been diagnosed as chip fractures of the vertebrae.

We have observed the results of treatment by exercises alone, by exercises and spinal support (usually a plaster jacket with the thoracic spine in extension), and by complete rest in bed in a plaster shell or on a hyperextended Bradford frame. It is our opinion that the type of treatment selected must depend upon the severity of the disease.<sup>4</sup> If treatment is started in the early stage of the disease, deformity can be prevented.

In the early stage of epiphysitis, when the involved portion of the spine can be extended fully in recumbency, exercises to improve the balance of the body and to obtain correction of the kyphos, when combined with sufficient rest and a good hygienic regimen, have pre-



TABLE II  
RESULTS OF TREATMENT

Type of Treatment	Duration of Treatment				Total (Cases)	Adults (Cases)
	4 Years and Over (Cases)	3 Years (Cases)	2 Years (Cases)	1 Year (Cases)		
Exercises alone . . . . .	4	1	3	12	20	7
Better . . . . .	2	1	3	12		6
No change . . . . .	1	0	0	0		1
Worse . . . . .	1	0	0	0		0
Support and exercises . . . . .	9	3	3	3	18	1
Better . . . . .	7	1	2	3		1
No change . . . . .	2	1	0	0		0
Worse . . . . .	0	1	1	0		0
Recumbency in hyperextension . . . . .	2	0	2	1	5	0
Better . . . . .	2		2	1		
No change . . . . .	0		0	0		
Worse . . . . .	0		0	0		
Total . . . . .	15	4	8	16	43	8

vented deformity in a small number of cases. Usually this is inadequate therapy, and more vigorous therapy must be instituted. The deformity can be partly or wholly corrected in the early stage of the disease while the patient is ambulatory, if a well-fitting plaster jacket is applied with the thoracic spine in as much extension as possible. As flexibility increases in the spine, exercises are given to improve the posture. New jackets are applied when further correction takes place.

If the child is growing rapidly, has poor general health, or is working beyond his physical capacity, there may be slow progression of the deformity during such treatment. Such children should be treated by prolonged recumbency in a plaster shell or on a hyperextended Bradford frame. In the severer forms of the disease, usually associated with widespread involvement of the spinal column, we have been able to prevent the deformity from increasing by recumbent treatment, but no improvement in the deformity has been observed. After the early stage of the disease is past, full correction of the deformity is not possible,<sup>12</sup> but much can be done with exercises and support to improve the balance of the body and to prevent strain on the back. After fusion of the epiphyses to the vertebrae, the changes remain practically constant throughout life, but the osseous spurs which we associate with hypertrophic arthritis will occur in these spines at a much earlier age.<sup>5</sup>

Forty-three patients were followed over one year (Table II). Of these, twenty-six have now attained their full growth. Twenty of the twenty-six have marked deformity. Eleven have pain on exertion, referred to the low back. This pain tends to be localized chiefly in the low

lumbar region. Three of the patients have had acute attacks of pain referred to the low back, with sciatic radiation. Seven have had pain in the intrascapular region. Undoubtedly more of these patients will complain of backache when they begin to work. Ten of them are still in school.

There were only three clinical cures of the deformity (Fig. 7). By this we mean correction of the deformity and the reappearance of normal flexibility in the spine. In two children who had uninterrupted early treatment, no deformity developed. Two patients, despite prolonged hyperextension in plaster, have grown worse. With the use of corrective exercises alone, some improvement in the deformity was noticed in eighteen patients. Most of these patients came for treatment during the healing stage of the disease, when much correction of the deformity was no longer possible. We believe that deformity can be prevented only when treatment is begun in the early course of the disease. Without treatment or with inadequate treatment, severe deformity and disability commonly result, as was shown in our adult cases.

#### SUMMARY

Epiphysitis of the spine is a relatively common lesion. Sixty-nine of our seventy-five patients were seen during the past six years. Most of these patients visited the hospital for the treatment of faulty posture; roentgenograms were essential for diagnosis. The disease was seen most frequently in rapidly growing children. In fourteen patients there was a familial history of similar spinal lesions. Laboratory studies upon these patients were essentially negative. Roentgenograms showed irregularity of the upper and lower surfaces of the vertebral bodies as the most constant finding. Decalcification of the vertebrae was observed in only eight patients. So-called Schmorl's islands were seen in twenty-one. The late change was constantly an anterior wedging of the vertebral body. All gradations of severity of the lesion were observed. With treatment, deformity was decreased, but rarely corrected. In two cases no deformity developed. In most instances treatment consisted in the application of a plaster jacket with the spine in extension and corrective exercises. During the acute early stage of the disease, recumbency in a plaster shell with the thoracic spine in extension, as was carried out in five cases, seemed to be the most efficient form of treatment. In our adult patients who had received no treatment or inadequate treatment, severe deformity was usually present. This was commonly associated with pain and weakness in the back.

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# CLAY-SHOVELER'S FRACTURE \*

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In Western Australia, the term "clay-shoveler's fracture" has been applied to a fracture of one or more spinous processes of the lower cervical or upper thoracic vertebrae, occurring in the great majority of cases in relief workers engaged in shoveling clay. It is only during recent years (since 1933) that this fracture has become a clinical entity and has been given its distinctive name, implying that it is an occupational injury. The main reason for this is of some interest. Commencing in 1933, numbers of unemployed men were provided with sustenance work of digging drains through clay soil to drain swampy areas in the southwestern portion of the State. The majority of these men, representing as they did the unemployable section of workers, were physically below normal standards. No special selection of them was made for this work, and practically all were out of training as well, owing to "standing off" periods of idleness. The drains were deep, and the clay had to be tossed up ten, twelve, or fifteen feet with long-handled shovels.

The history of the accident is the same in practically all cases: The laborer throws up a shovelful of clay; the clay sticks to the shovel; and the worker feels a sudden stab of pain and sometimes hears a crack somewhere between the shoulders, and is unable to continue working.

A similar fracture occurs rarely in laborers employed in other occupations, — for example, in shoveling other materials, when the shovel is suddenly stopped by a hidden obstruction; and in tree-grubbing, as in the case in this series when the patient was merely pulling on a root.

In this series of thirteen cases, eleven of the patients were employed in digging drains,—that is, in shoveling clay; one was a gravel shoveler; and one was a tree grubber.

TABLE I  
SITE OF FRACTURE IN THIRTEEN CASES

No of Cases	Site of Fracture (Spinous Process of)
1	Sixth cervical vertebra
6	Seventh cervical vertebra
1	First thoracic vertebra
1	Sixth and seventh cervical vertebrae
3	Seventh cervical and first thoracic vertebrae
1	Second and third thoracic vertebrae

\* Read at the Inaugural Meeting of the Australian Orthopaedic Association, Sydney, New South Wales, March 1938

The site of fracture is most commonly the spinous process of the seventh cervical vertebra, but it ranges in this series from the sixth cervical to the third thoracic vertebra, and in four of the cases two adjacent vertebrae were affected (Table I).

#### ANATOMY

In order to understand the causation of this injury, it is necessary to review in brief the anatomy of the region in so far as it applies particularly to the muscle attachments of the spinous processes. In the first place, a spinous process, which has a broad base when it leaves the vertebral arch, tapers to a point about one-half to three-fourths of an inch from the tip, whence it expands again to form the bulbous extremity. Secondly, the expanded tips of the spinous processes distal to these narrow portions give origin to the thoracoscapular and costovertebral muscles and to the supraspinal and interspinal ligaments. The origins of the thoracoscapular muscles particularly appear to afford an explanation both of the localization of the lesion to the region between the sixth cervical and the third thoracic vertebrae and of the direction of displacement of the distal fragments.

#### *Trapezius*

This muscle has a long and uniform aponeurotic origin, extending from the base of the skull to the spinous process of the last thoracic vertebra. The upper fibers extend obliquely downward and forward to be attached to the posterior margin of the outer third of the clavicle; the middle fibers extend transversely to the acromion process and to the spine of the scapula; while the lower fibers extend obliquely upward and laterally to become attached by a small, triangular, flat tendon to the medial portion of the spine of the scapula.

*Action:* Contracting as a whole, the trapezius draws the shoulder blade toward the spine and rotates it in a counterclockwise direction. No doubt, the various portions of this muscle can act independently, or at any rate some portions can contract more powerfully than others in order to bring about a certain movement.

#### *Rhomboideus Major*

This muscle arises from the spinous processes of the first, second, and third thoracic vertebrae, and its fibers are directed downward and outward to be attached to the vertebral border of the scapula.

*Action:* It draws the scapula as a whole upward and toward the spine and draws the inferior angle medially.

#### *Rhomboideus Minor*

This is really the cranial portion of the rhomboideus major and arises from the spinous processes of the sixth and seventh cervical vertebrae.

*Action:* Its action is similar to that of the rhomboideus major.

*Serratus Posterior Superior*

This muscle arises from the spinous processes of the sixth and seventh cervical vertebrae and of the first and second thoracic vertebrae, and its fibers run downward and outward to be inserted into the second, third, fourth, and fifth ribs.

*Action:* It elevates the ribs.

## ETIOLOGY

It is suggested that the causation of clay-shoveler's fracture is closely associated with the origins and actions of the trapezius (middle portion), the rhomboideus major, and the rhomboideus minor; the serratus posterior superior acts merely as an accessory to these muscles, for, when the worker is in the act of throwing, this muscle is probably in full contraction, thus helping to fix the chest.

It seems that there are three possible mechanisms by which this fracture may be explained:

1. Direct muscle violence;
2. Reflex muscle contraction;
3. Whip-like pull transmitted through the supraspinal ligaments.

*Direct Muscle Violence*

The spinous process is fractured by the direct pull of the muscles involved in the act of heaving the shovelful of clay upward. This action is performed in the main by the trapezius assisted by the rhomboidei, while the serratus posterior superior contributes its pull in fixing the chest. In a right-handed man this mechanism should produce symptoms on the right side, for the muscles mentioned would be drawing the right scapula back to the mid-line in order to lift the shovel. This seems the only feasible explanation in those cases which occur when the shovel meets with a sudden unexpected obstruction to its forward movement, as well as in those caused by a direct pull.

*Reflex Muscle Contraction*

When, as commonly appears in the history of the accident, clay sticks to the shovel, the momentum of clay and shovel acting through the arm would pull the scapula farther away from the spine and call into being a sudden reflex contraction of the trapezius, the rhomboideus major, the rhomboideus minor, and probably also the serratus posterior superior, to resist this unexpected movement. This sudden contraction may snap off the spinous process. In a right-handed shoveler this should cause symptoms on the left side.

In both cases the fracture occurs at the weakest point in the spinous process, which is the narrowest portion and is from one-half to three-quarters of an inch from the tip. There is practically no variation in this site. It would appear probable that variations in development of the different bands of muscle arising from the various spinous processes,

combined with individual variations in thickness and strength of the spinous processes themselves, would determine which actual process (or processes) is fractured.

### *Pull through the Supraspinal Ligaments*

It may be that in some cases there is a sudden strain acting through the ligamentum nuchae by reason of a forward jerking of the head, such as occurs when by mistake one takes a step down in the dark when no step is present. This mechanism may be conceived as a whip-like jerk.

### *Discussion*

Unfortunately, in this series of thirteen cases, there is no evidence in the records as to whether the patients were shoveling with the right or the left hand at the time of the fracture, nor is it indicated in many cases whether the symptoms and signs were right-sided, left-sided, or confined to the mid-line. A further case has been seen, in which personal questioning on these points seems to throw considerable light on the problems. This man was shoveling right-handed,—that is, with the left hand grasping the end of the handle and the right hand some distance along toward the blade. He is quite certain that the pain occurred as he was in the act of heaving the shovel up and before he had initiated the motion of jerking the clay off the shovel. In his case the spinous process of the seventh cervical vertebra was fractured, and the signs and symptoms were all right-sided. This, of course, suggests that the fracture was caused by direct violence, and is supported by the histories of two other cases,—Case 1, that of a man pulling out a root; and Case 10, that of a man shoveling slime. In the latter case the patient stated that “the sudden pull caused me to wrench my back”. There is one other case (Case 11) in which we have definite evidence that the clay did not stick to the shovel, and another case (Case 5) in which the patient’s feet slipped, but we are not informed whether or not the clay stuck.

On the other hand, there are four cases in which the history states that the clay stuck to the shovel, thus supporting the second theory of causation, but we do not know whether these men were shoveling right-handed or left-handed. Had the histories stated these points, we could have been more certain whether or not this is a factor, since the signs and symptoms should appear on the side of the hand grasping the end of the shovel handle. The possible fallacy here, of course, lies in the fact that the clay may not have left the shovel, because the fracture occurred an instant before the jerk would have been applied, and so was not the cause but the effect of the accident, which may still have been brought about by direct muscle action. In these cases, too, the third explanation may be the correct one,—the jerk of the clay sticking to the shovel produces a jerk of the head, which, acting through the supraspinal ligaments, causes the fracture.

However, since in general the symptoms are unilateral and the

signs implicate muscle fibers to one side only of the spinous processes, it seems that the theory of direct muscle violence is the most acceptable one to explain the majority of these fractures.

#### SYMPTOMS

The patient complains of pain between the shoulder, nearly always to one side of the mid-line and sometimes beneath one scapula. The pain is worse on forward stretching of the arms, or on attempting to pull or to lift anything, or, in fact, on performing any action which would produce a passive movement of the scapula away from the mid-line or an active one toward it. Sometimes the pain goes up to the head or down the spine; occasionally it attacks both the head and the spine; and in some instances it proceeds down the arm, which invariably feels weak. Frequently the patient hears a click on performing certain movements, and in old cases aching before wet weather is often noted.

#### SIGNS

Examination reveals tenderness of the spinous process at the site of fracture, and tenderness along the course of the rhomboidei, on one side, is always present if looked for. Likewise, mobility of the affected spinous process can usually be detected. Pain and tenderness do not as a rule spread across the mid-line. Pain on active contraction or passive stretching of the rhomboidei or the trapezius is invariable. Sometimes crepitus or clicking can be demonstrated either by the examiner or by the performance of certain movements on the part of the patient. Flexion of the head invariably produces pain.

#### DIAGNOSIS

In the majority of cases, the provisional diagnosis has been "muscle strain". In only one case (Case 10) was the condition suspected at the first examination, and in that case the patient was not a clay shoveler. The diagnosis should be suspected from the history of the injury; it should be made certain by an efficient clinical examination; and it should be confirmed by the roentgenographic findings.

#### ROENTGENOGRAPHIC FINDINGS

Good lateral roentgenograms reveal the fracture without difficulty, with the exception of those cases in which the upper thoracic spine is the seat of the fracture, or in cases of the bull-neck type. Stereoscopic anteroposterior views also show the fracture clearly in most cases.

#### TREATMENT

In the majority of cases, the provisional diagnosis has been responsible for delay in instituting the correct treatment and for the consequent delay in returning the patient to work. In practically all of the cases in this series, the diagnosis was "muscle strain", and the patients were



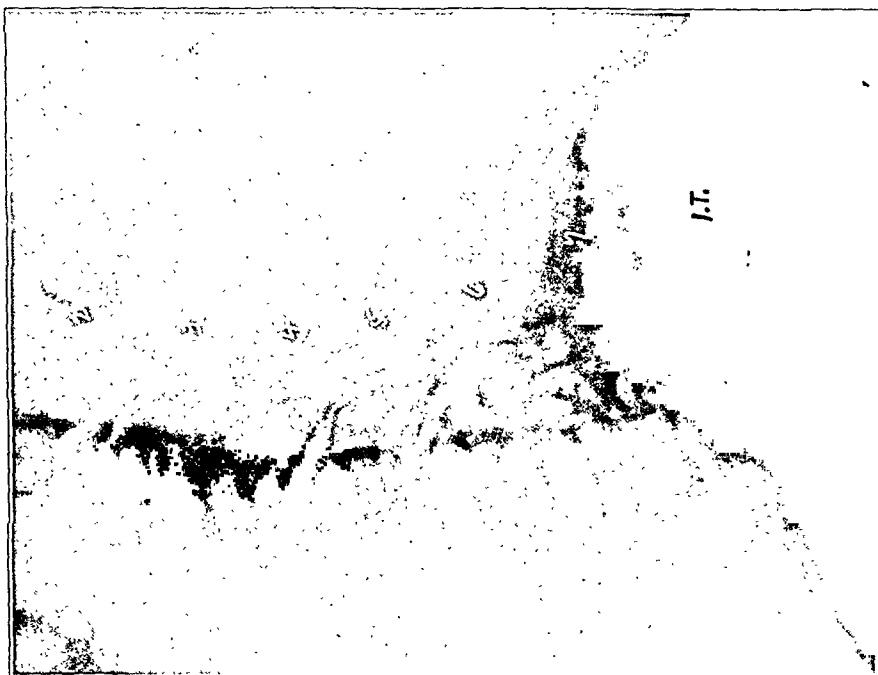


Fig. 1

Case 3. Before operation. Fracture of spinous processes of seventh cervical and first thoracic vertebrae, showing downward displacement, which is visible in the anteroposterior film as well as in the lateral film.



Fig. 2

Case 3. Before operation. Lateral view. The fracture of the spinous process of the first thoracic vertebra is not visible in the print, but can be seen in the anteroposterior view (Fig. 1).

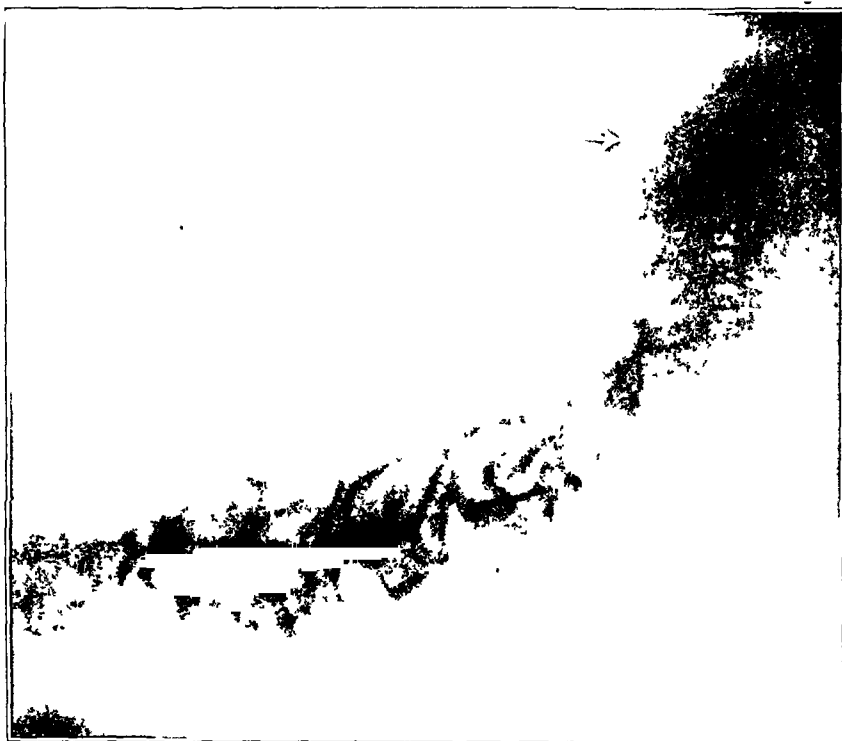


FIG. 1

Case 3. After operation. Lateral view, showing spur on the stump of the spinous process of the seventh cervical vertebra



FIG. 3

Case 3. After operation, at which the loose fragment of the spinous process of the seventh cervical vertebra only was removed. The fracture of the first thoracic vertebra has united

treated in the main with massage and movement. The treatment indicated is early removal of the detached fragments. Late removal is not so successful, for the reason that the patient, having made no progress under the treatment instituted, loses confidence when informed that he has a fracture which has not united and that the loose fragment will have to be removed by operation. He then rapidly develops the idea that he has not been properly treated, and will not return to work until he has been completely cured. The failure is, the author believes, more mental

than physical. In one of the early cases in this series (Case 2), the patient was treated by grafting the spine from the first thoracic vertebra to the fourth, including the fractured processes of the second and third thoracic vertebrae. This case was the first in which the patient was returned to work without disability.

From the case histories which are appended it may be difficult for the reader to draw any conclusions as to the relative value of operative or non-operative treatment, on account of the varying factors involved—age, fitness, mentality, financial situation, whether or not the patient was working, time elapsing between



FIG. 5

Case 7. Early operation. Condition did not clear up. X-ray shows localized osteophytic outgrowth from lower anterior margin of the sixth cervical vertebra.

injury and correct diagnosis, etc.—but it is the clinical opinion of those who have seen the cases that early removal is doubtless the treatment of choice.

#### RESULTS OF TREATMENT

Four cases (Cases 1, 10, 11, and 13) were treated conservatively and will be designated as Group A. These appear to show the best results, but it is

significant that included in this group are the only two cases in which the patients were not relief workers and who had more to lose financially by remaining away from work. Furthermore these two patients were the youngest in the series. One of the other patients in this group refused operation and hence was under an obligation to get better speedily or he would be denied compensation for refusing to follow medical advice.

The most recent case, not included in Group A, has been treated conservatively for ten months, owing to non-recognition of the fracture. The patient now has an area of traumatic myofibrositis, with pain, tenderness, and thickening in the portion of the trapezius overlying the supraspinatus muscle and in the rhomboideus minor. This condition more than the fracture, which is still ununited, is the cause of his inability to work. He suffers referred pain of a burning type, which shoots up to the base of the skull and down the arm. This condition has been noted in several of the patients who have not been seen until several months after the injury. Compensation neurosis cannot always be blamed entirely for the delay in recovery.

It has been suggested that excision of this area might shorten the period of disability, since it appears that in an open injury to a muscle, even though it be a gunshot wound, recovery is more rapid than in a closed one.

The nine patients on whom an operation was performed can be divided into two groups: Group B, six patients (Cases 2, 3, 5, 6, 8, and 12) who were cured; Group C, three patients (Cases 4, 7, and 9) who showed some permanent disability upon final examination.

In Group B it was noted that generally speaking the longer the time elapsing before operation, the longer the recovery period. The best result in the whole series was obtained in Case 6,—the patient, fifty-two years of age, was operated upon two weeks after the injury

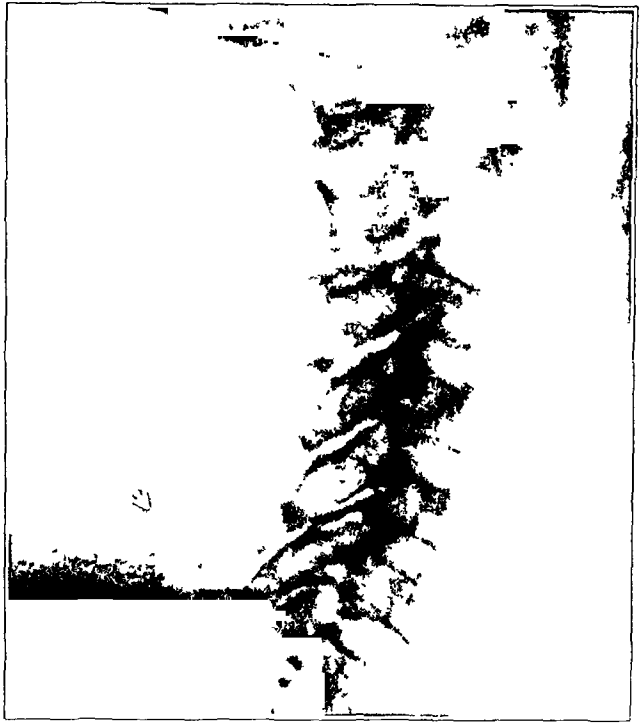


FIG. 6

Case 8. Showing typical displacement.

and was able to resume his regular work in two and three-fourths months.

In Group C, failure resulted in two cases because of errors in surgical technique and in one case because the disability was due not to the fracture, but to a coincident tearing of some roots of the brachial plexus. In one case, spur formation from the stump to the spinous process occurred, probably the result of inattention to detail in not smoothing off the fractured end of the process. In the other case of faulty technique, suppuration occurred at the second operation, due to the fact that only one of the two fractured spines had been removed at the first operation. Even if the following case histories do not clearly demonstrate it, there is no doubt in the minds of surgeons who have seen many of these cases that early operative removal of the fragments is the proper routine treatment. This is contrary to the advice given by such world-famous authorities as have been consulted.

#### SUMMARY OF CASE HISTORIES

Unfortunately, in many cases the records are incomplete; roentgenograms are missing, and interesting points in relation to the history of the injury, the operation, etc., are omitted.

CASE 1. Patient, aged forty-nine years, with fracture of the spinous process of the seventh cervical vertebra, apparently caused by direct strain while pulling a root; the history does not state whether the root came away unexpectedly. A diagnosis of "strain of the left trapezius muscle" was made. No operation was performed, and the patient did not work for two and one-half months. Sixteen months later, the same region was strained when the patient struck at a root with a mattock and met with no resistance. He did not work for two and one-half months, and unfortunately no roentgenograms were taken. He had completely recovered from the first accident. Two and one-half years later, the lumbosacral region was strained, and at that time the patient stated that he had never had any trouble at the site of the old injury.

CASE 2. Patient, aged forty-eight years, with a fracture of the spinous processes of the second and third thoracic vertebrae, incurred while shoveling clay; he stated that the clay had stuck to the shovel. A diagnosis of "strained muscles" was made. The patient did not work for three weeks and then went back to work for three weeks, when "it went again". Roentgenograms, taken three weeks after injury, showed fracture of the spinous processes of the second and third thoracic vertebrae. Nine and one-half months after the accident, the patient was still incapacitated, and an operation was performed. A graft was inserted from the first thoracic vertebra to the fourth thoracic vertebra on either side of the processes which were ununited. Six and one-half months later, the patient returned to work without any permanent disability. It is interesting to speculate whether one process was fractured at the first accident and the other at the second or whether both were broken at the second accident; probably the latter is the correct supposition.

CASE 3. Patient, aged forty-three years, with fracture of the spinous processes of the seventh cervical and first thoracic vertebrae. The patient stated that, while shoveling clay, he had felt severe pain in the neck and between the shoulders. He was treated for one and one-half months for debility, asthma, psoriasis, and strain of the right trapezius and rhomboidei. Before a roentgenographic diagnosis was made five months after the accident, an operation was performed, and three months later the patient was signed off, but did not resume work. "Neuritis" developed, which was later found to be due to the downward growth of a spur from the stump of the spinous

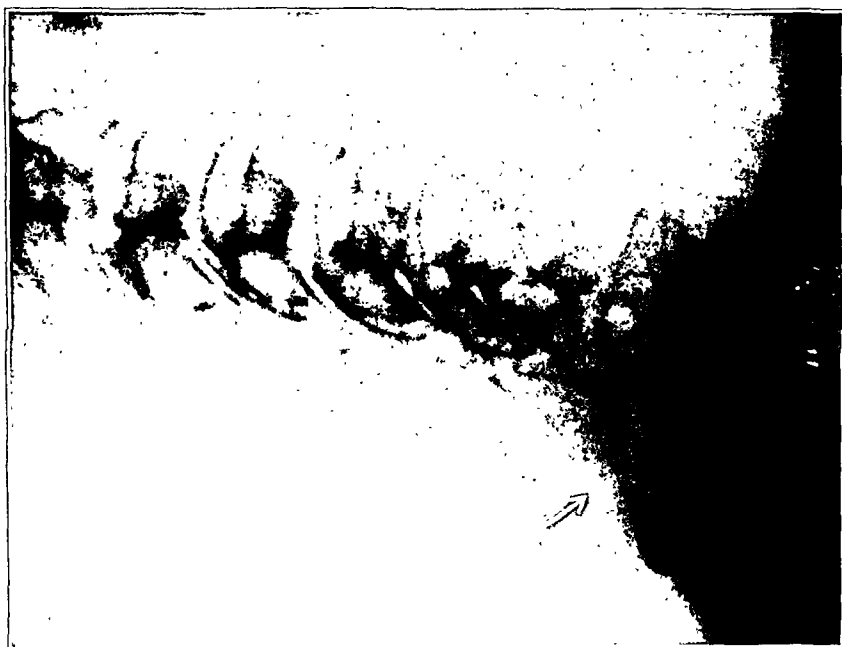


FIG. 8

Case 13. Lateral view.



FIG. 7

Case 13. Anteroposterior view, showing the fracture gap in the space between the bodies of the seventh cervical and the first thoracic vertebrae.

processes of the sixth and seventh cervical vertebrae. Roentgenographic examination showed also that the spinous process of the first thoracic vertebra had not been removed, and, moreover, that the fragments had united. The patient signed off nine months after operation, with partial permanent disability, but not sufficient to affect his wage-earning capacity.

CASE 4. Patient, aged fifty-six years, with fracture of the spinous process of the seventh cervical vertebra. While shoveling clay, the patient had felt sudden pain between the shoulders and under the right shoulder blade. He was treated for two and one-half months for "myositis" before the roentgenogram revealed the cause. Settlement of the case was then advised, because of a suspicion of paralysis of a hemiplegic type. Three months later, a consultant diagnosed the condition as a lesion of the lower motor neuron from tearing of the central roots of the brachial plexus. Two months later, roentgenographic examination showed non-union, and the process was removed. Four months later, the case was settled on the basis of 33 per cent. permanent disability of the left arm.

CASE 5. Patient, aged thirty-nine years, with fracture of the spinous process of the seventh cervical vertebra. The patient stated that his foot had slipped in greasy clay while he was throwing a shovelful of clay. He was treated for three months for muscle strain before operative removal of the process. He finally returned to work after an unsatisfactory try-out seven months after the accident. He staged another "recurrence", but was sent back to work by a consultant as a malingerer. There were no further complaints.

CASE 6. Patient, aged fifty-two years, with a fracture of the spinous process of the seventh cervical vertebra, sustained while shoveling clay. A diagnosis of "injured back" was made, and an operation was performed in a fortnight. The patient returned to work two and one-fourth months after the accident.

CASE 7. Patient, aged forty-five years, with fracture of the spinous process of the seventh cervical vertebra. The patient stated that, while shoveling clay, he had felt something snap. A diagnosis of "strained back" was made. In spite of an early operation, the condition did not clear up. Roentgenographic examination showed a localized osteophytic outgrowth from the lower anterior margin of the body of the sixth cervical vertebra. A further diagnosis of "localized spondylitis" was made. The patient was given further disability payment for twelve months.

CASE 8. Patient, aged forty-one years, with fracture of the spinous process of the sixth cervical vertebra, incurred while shoveling clay. A diagnosis of "strain of the right latissimus dorsi" was made. An operation was performed one and three-fourths months after injury. A ligament "click" developed across the stump of the spinous process. The patient did not work for seven months. He had no permanent disability.

CASE 9. Patient with fracture of the spinous processes of the sixth and seventh cervical vertebrae. The patient stated that, while shoveling clay, the clay had stuck to the shovel. Treatment consisted in early removal of the spinous process of the sixth cervical vertebra. After an interval of six weeks, the spinous process of the seventh cervical vertebra was removed. There is no available information as to the reason for leaving it at the first operation. Following the second operation, sepsis developed. Later examination revealed arthritis of the sixth and seventh cervical vertebrae. A graft was inserted, which slowly necrosed. The patient was still unfit three and one-fourth years after the accident. He was given compensation of £400, fifteen months after the accident.

CASE 10. Patient, aged twenty-two years, with fracture of the spinous process of the first thoracic vertebra, sustained while shoveling slime; there was no history that the shovel had struck an obstacle. The fracture was diagnosed correctly at once. The patient did not work for two and one-half months. On his return, he could not keep

pace with contract work and stopped working for another month. He then returned to work presumably cured.

CASE 11. Patient, aged twenty-seven years, with fracture of the spinous processes of the seventh cervical and first thoracic vertebrae, sustained while shoveling clay; the clay did not stick to the shovel. A clicking sensation was felt six weeks later. The patient was treated with antiphlogistin, and refused operation. He did not work for three and one-half months, but is now cured.

CASE 12. Patient, aged forty-six years, with fracture of the spinous processes of the seventh cervical and first thoracic vertebrae, incurred while shoveling clay. A diagnosis of "strained cervicothoracic muscles" was made. The patient did not work for three weeks, and then after two days' work there was a recurrence. Roentgenographic examination revealed the fracture. Operative removal of the fragments was done six weeks after the original accident. The patient returned to the country sixteen days after the operation and resumed work six months after the operation. This delay was probably unnecessary and would not have occurred if the patient had been kept in town. Whether the fractures occurred separately or at the first or the second accident is a matter for conjecture.

CASE 13. Patient, aged forty years, with fracture of the spinous process of the seventh cervical vertebra. The patient stated that, while lifting a shovelful of clay, the clay had stuck to the shovel and he had felt something crack. A diagnosis of "probable strained muscles" was made. Operation was refused, and the patient resumed work three months later. There were no further complaints.

Since this paper was written, two additional cases have appeared in the author's practice,—in one case, that of a farm laborer, the fracture occurred while the patient was pitching hay; in the other case, that of a well-built Italian miner, the fracture took place while the patient was shoveling slime, which stuck to the shovel.

The author is indebted to Dr. F. Lovegrove of the State Accident Insurance Office for permission to use the records of his office from which most of the material used in this paper has been obtained.



# UNUNITED FRACTURE OF THE NECK OF THE FEMUR IN THE AGED \*

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The great improvement in the treatment of recent fractures of the neck of the femur that has resulted from the contributions of Smith-Petersen, Johansson, and others has naturally led to a reconsideration of those cases in which, for one reason or another, union has failed to take place. In such patients, if they are reasonably robust, the standard treatment, consisting in an open operation with freshening of the surfaces of the fracture and the introduction of a bone graft or, better, a Smith-Petersen nail and a bone graft, usually accomplishes a cure. Most of us have hesitated, however, to submit elderly people to the hazards of such an extensive operation, and it was in an effort to lessen these risks that our present plan of introducing the Smith-Petersen nail and a bone graft, without exposure of the fracture, was evolved.

One might suppose that the shortening and the adduction deformity

that always accompany non-union would present serious difficulty. This has not been the case, however, for, with a few days of heavy traction applied with a Kirschner wire through the lower end of the femur, the fragments have come into nearly as good position as would have been possible on the day of the accident.

The fragments are then nailed. The technique is that of Johansson, with the single modification that the nail is placed close to the lower border of the neck, so as to leave room for a graft above it. A half-inch hole is then bored into the neck and head, parallel with the nail, and

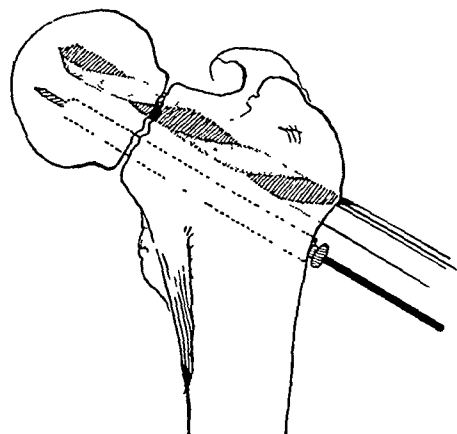


FIG. 1

Diagram to show introduction of nail and drill after reduction of displacement by traction.

into it a suitable bone graft, cut from the crest of the ilium, the tibia, or the fibula, is inserted. (See Figure 1.)

Our experience with this method is based on fifteen cases. In one of these, failure resulted, owing to technical errors; in six, the fragments have solidly united, and the patients are walking well; and in the remainder, the patients are still in bed or on crutches. The latter cases give evidence that they will be successful. Naturally, union takes place

\* Read at the Annual Meeting of the American Orthopaedic Association, Buffalo, New York, on June 7, 1939.

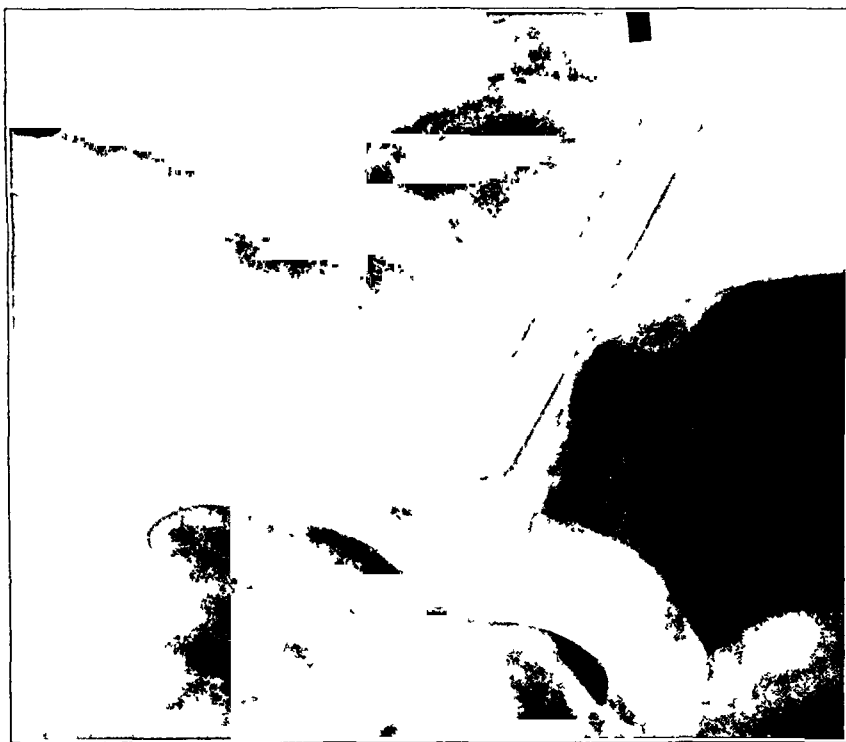


FIG. 3

Same hip as shown in Fig. 2, one year after reduction of displacement and introduction of nail and graft.



FIG 2

Ununited fracture of twelve months' duration.



FIG. 4

Ununited fracture of eighteen months' duration.



FIG. 5

Roentgenogram of same hip as shown in Fig. 4, two months after reduction of deformity and introduction of nail and graft. Note the persisting space between the fragments.

more slowly than in fresh fractures or in ununited fractures that have been dealt with by open operation, but most of the patients are up in a chair in six months and are walking in two or three months more. (See Figures 2 and 3.)

An interesting modification of this procedure was tried on a patient in whom, after the introduction of the nail and the graft, so wide a space persisted between the fragments that it seemed unreasonable to expect strong union ever to occur. After the lapse of six months, therefore, at which time there was fair evidence of union, the nail was extracted and replaced with a segment of fibula, which had been split to allow lymph to reach its interior. This has resulted in excellent union. (See Figures 4, 5, and 6.)

So impressive has been the success of this combination of the nail and the graft in overcoming non-union of months' and years' duration that we think there is a place for the method even in fresh fractures, particularly those in which, after the introduction of the nail, we have misgivings about the prospect of union. We have no thought that a graft is necessary in all cases, but if, after the nail has been driven home, there is something about the appearance of the roentgenogram that makes one anxious about the ultimate success of the operation—such as a space between the fragments or some inaccuracy in their contact—we suggest that a graft be added to the nail. We have done this in several cases, either at the same time as the nailing or two weeks later, and we feel sure that it reduces the chance of failure.

It will be recognized at once that what we are advocating contains no new principle, for we have had before us for many years the recommenda-

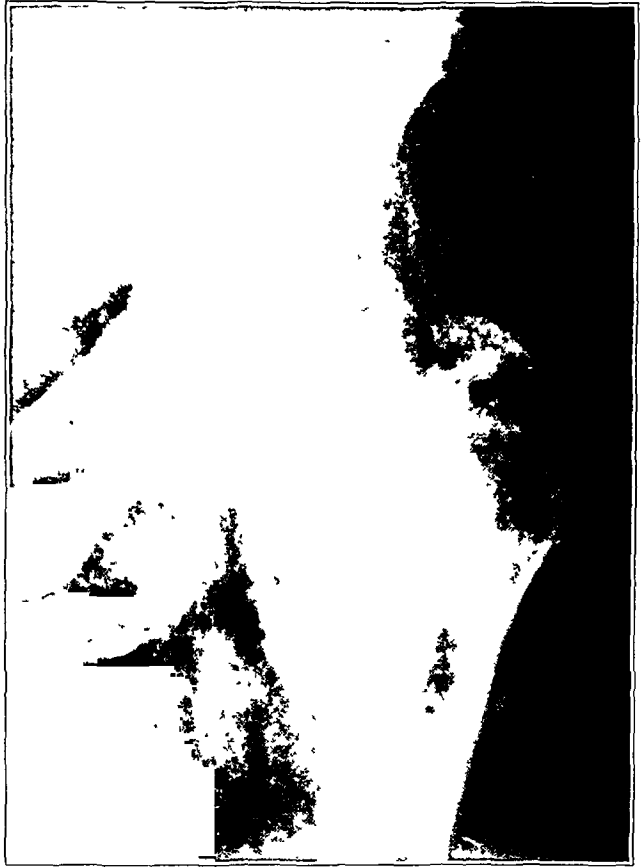


FIG. 6

Roentgenogram of same patient as in Figs. 4 and 5, six months after replacement of nail by segment of fibula. Patient is now walking.

tions of Albee in regard to open operation and the insertion of the bone graft, of Delbet with reference to the blind introduction of the fibular graft, of Smith-Petersen, Johansson, and others in respect to the introduction of nails and grafts, and, more recently, of King, who describes a method very similar to our own. What we wish to emphasize is that by a combination of some of these excellent operations we can extend the possibilities of a cure to those old people who cannot be expected to stand a major operation and who, nevertheless, have a sufficient expectation of life to make us loath to abandon them.

# SURGICAL CORRECTION OF TALIPES CAVUS DEFORMITIES

BY ALVIA BROCKWAY, M.D., LOS ANGELES, CALIFORNIA

*From the Clinics of the Orthopaedic Hospital, Los Angeles*

Most of the literature on the surgical correction of cavus-foot deformities does not limit itself to the congenital or the acquired deformities, but includes also those due to poliomyelitis and cerebral hemorrhage at birth. On such a basis, comparisons of methods of treatment cannot properly be made and conclusions as to the efficacy of various operations cannot accurately be drawn, because the principles of treatment in these conditions are distinctly different.

In poliomyelitis, stability of the foot is often much more important than motion, particularly uncontrolled lateral motion, and various muscle transplantations to rebalance the muscle power are indicated; this does not apply to the cavus foot of the congenital or the acquired type. Preservation of lateral motion is of fundamental importance in the true cavus foot. Furthermore, there is no demonstrable weakness in this type of foot. Muscle transplantations, therefore, are seldom necessary, and, when done, are only of secondary importance, as for instance when the toe extensors are transplanted to the dorsum of the foot to improve hammer-toe deformities.

In 1924 Hackenbroch wrote a very complete and comprehensive article on the whole aspect of the cavus foot. He did not limit himself to discussion of the congenital and acquired types of cavus foot, but these types were very thoroughly treated. He gave not only his own opinions and practices, but also those of many different men who have written on the subject.

The following report is based on a study of seventy feet that were operated upon for cavus deformity of the congenital or the acquired type, with an average postoperative follow-up period of four years.

## ELEMENTS OF DEFORMITY IN THE CAVUS FOOT

In the cavus foot, one, two, or three elements, or certain combinations of these three elements, may enter into the deformity.

The most common aspect of the deformity is a drop of the forefoot. The apex of the deformity on the inner border of the foot is more frequently at the navicular-cuneiform joints rather than at the astragalonavicular joint. In either case, the surgical indication is to bring up the forefoot into proper relation with the hindfoot.

The next most common element of the deformity is a true equinus condition, in which the heel cord is actually short and is accompanied by the drop of the forefoot just described. In this type, of course, it is necessary to lengthen the heel cord in addition to restoring the relationship between the forefoot and the hindfoot.

The third element is a combination of drop of the forefoot and a varying degree of calcaneus deformity. In this instance the heel cord is too long, and the os calcis forms a greater than normal angle with the

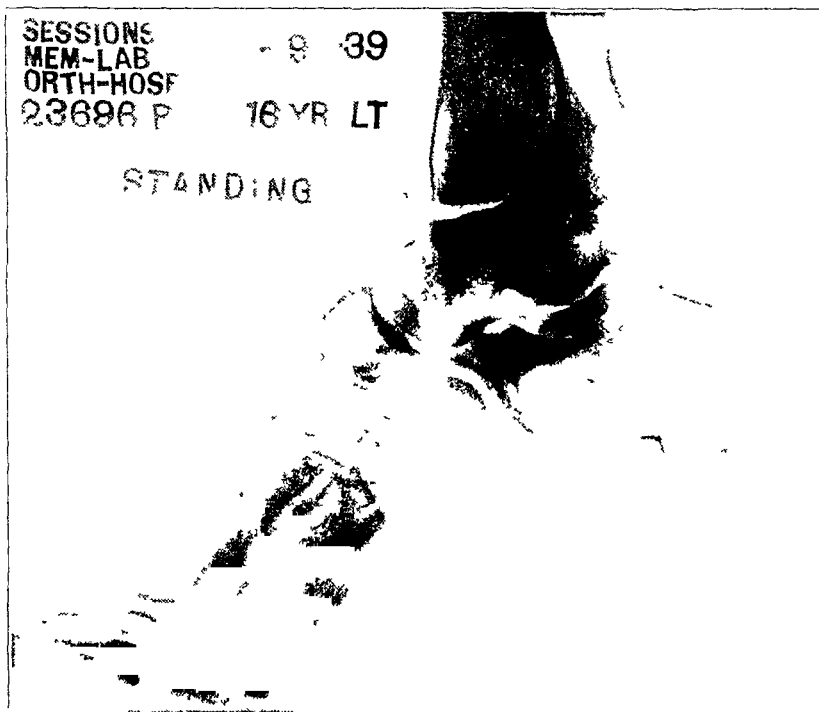


FIG. 1-A

Cavus deformity of moderately severe degree. The deformity is essentially a drop of the forefoot.



FIG. 1-B

Same foot as shown in Fig. 1-A after surgical correction. Wedges of bone, with bases upward, have been removed from the navicular-cuneiform joints and from the body of the cuboid. Lateral mobility of the foot has been preserved.

longitudinal axis of the tibia. In spite of the calcaneus deformity, actual weakness of the gastrocnemius muscle usually cannot be demonstrated. The apex of the cavus deformity is more posterior than in those types in which the deformity is only a drop of the forefoot.

In some instances there is an associated varus deformity of the heel. Also, in the cases of more pronounced deformity, there is a high incidence of hammer-toe, sufficient to require surgical attention.



FIG 2-A

Severe degree of cavus deformity, but very little shortening of the heel cord.

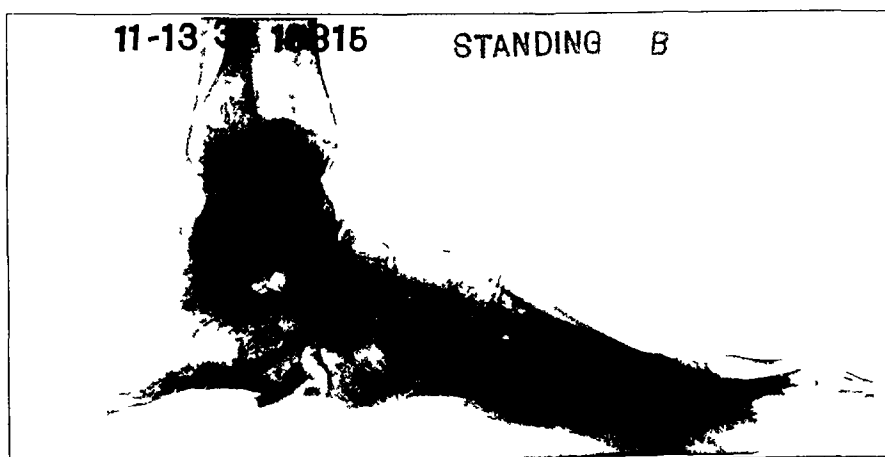


FIG. 2-B

Same foot as shown in Fig 2-A after surgical correction. Wedges of bone, with bases upward, have been removed from the astragalonavicular and from the calcaneocuboid joints. Lateral motion of the foot has been obliterated.



## TYPES AND TREATMENT OF CAVUS FEET

From a clinical and therapeutic standpoint, patients with cavus feet may be roughly divided into three main groups.

*Group I*

In this group are included those patients with only a moderate degree of deformity, but sufficient to require surgery. While these patients vary in age, the majority are under ten years, most of them being between seven and eight years. At this age and with only a moderate degree of deformity, foot symptoms are usually slight, but this fact should be no deterrent to surgery, particularly if the history shows a familial tendency or if observations have demonstrated that the deformity is progressing.

It is in this group that the Steindler stripping of the os calcis alone has its greatest field of usefulness. Yet, even at this age, it is surprising usually to discover how little correction can be obtained by this type of surgery. At this age there is already considerable change in contour of the bones and joints, as well as adaptive shortening of the capsule, so that release of the tight plantar structures is not always sufficient to obtain good correction. Moreover, if correction is obtained, there is considerable tendency to relapse and progression of the deformity.

There were nineteen feet in the author's series which were subjected to this operation. Of these, there was sufficient relapse in six to require further surgery later, and in four others additional surgery should have been done. From a study of these feet, it seemed reasonable to believe that relapse was partly due to the fact that the period of immobilization following surgery was too short. The average time in plaster in this series was only six weeks. Better correction was maintained when the feet were immobilized for several months, permitting the patient to walk when the wounds were healed.

When one considers that in these feet the deformity gradually progresses, it seems reasonable to believe that prolonged plaster immobilization should be the rule. There may be some analogy between cavus and club-foot deformities; in the latter condition, the fact is well established that it is important to maintain correction for a long time, even up to the end of the growth period. The author believes that the same reasoning and principles should be applied in treating the cavus foot.

In spite of the facts that complete correction is often impossible and that relapse frequently occurs after the Steindler stripping operation, the writer feels that it is a useful procedure in this younger age group. In the first place, at the age of six or eight years, the deformity is of the milder type, and fair to good correction can usually be obtained. Most surgeons would hesitate to do bone surgery, such as wedge osteotomies, at this age, because of the hazard of growth disturbance and because bony fusion is less likely to occur. If these feet are watched regularly after the casts have been discontinued, if they are properly shod, and if exercises and

stretching are instituted, it is possible to carry the patients through the end of their growth period with useful feet. At least there will be a minimum of deformity, and, if bone surgery should become necessary, such surgery would be less radical and greater suppleness and pliability of the feet would be maintained, with less residual deformity and pain.

### *Group II*

In this group the foot deformity is more severe, and the majority of the patients are between ten and fifteen years of age. The deformity is

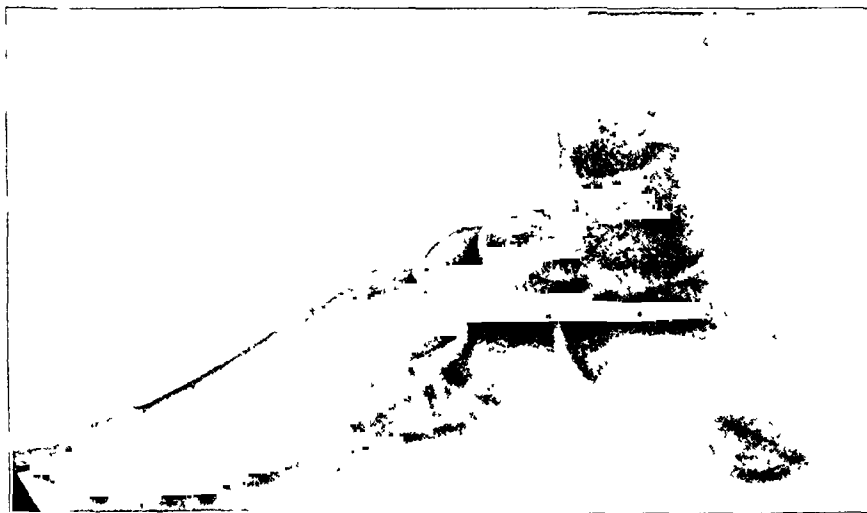


FIG. 3-A

Moderate cavus deformity with mild calcaneus.



FIG. 3-B

Same foot as shown in Fig. 3-A after surgical correction. Wedge osteotomies were done through the neck of the astragalus and through the cuboid.

fixed by reason of structural changes in the bone, and the Steindler stripping of the os calcis alone will not alter the contour of the foot. It is necessary, in addition, to do wedge osteotomies somewhere in the mid-tarsal region, with the base upward in order to flatten the arch.

It is in this type of deformity that Steindler's recommendation of wedge osteotomies through the body or the neck of the astragalus and through the cuboid, in order to spare the mid-tarsal joints, should be carried out. This operation gives fairly good correction, and, since the mid-tarsal joints are not invaded, the patient has a flexible foot with no limitation of motion in the subastragalar joint. This fact should be borne in mind in treating feet that are not paralyzed as in poliomyelitis. In the latter condition the surgeon willingly sacrifices lateral motion of the foot for the sake of increased stability. In the unparalyzed foot this loss of lateral motion greatly decreases function and increases discomfort.

Operations of this type were performed on five feet in the author's series with good results. There was fair to good correction of the deformity with marked to complete relief of symptoms. In each case, when the foot was relaxed, the deformity was still very apparent, but, when the patient stood, the cosmetic appearance of the foot was good.

This operation is usually not sufficient when the deformity is more marked. In the first place, it is difficult or impossible to remove adequate bone wedges, and, in the second place, the apex of the deformity is usually more distal than the region from which the bone is removed. Hence, removal of an inadequate wedge behind the actual deformity may not give proper correction.

In 1927 Royle called attention to a new conception of the etiology of the cavus foot and described an operation to correct the deformity. He believed that, due to weakness of the gastrocnemius, the patient consciously or unconsciously used the tibialis posterior to assist in locomotion. This constant overuse of the tibialis posterior, he felt, caused flexion of the mid-tarsal joints, which resulted finally in a cavus foot. Some of the cases which he described were clearly due to poliomyelitis, but he thought that in some cases the cavus deformity was of the congenital or the acquired type. Based on this conception of the etiology, he transplanted the tendon of the tibialis posterior into the tendo achillis, both to increase the motor power of the calf and also to release the deforming action of the tibialis posterior on the mid-tarsal joints.

In the author's series of seventy feet, with the possible exception of two, none fitted into this classification of Royle's, and it seems possible that most of the latter's cases may have been the result of poliomyelitis. In none of the writer's patients could weakness of the gastrocnemius be clearly demonstrated, even when there was a calcaneus element in the cavus deformity. In some of Royle's cases he described a heel-cord lengthening, indicating that there was a shortening of the calf muscle. If the calf muscle were weak, one would expect the reverse of this condition,—that is, a heel cord that was too long and a calcaneus deformity.

There were two cases in this series in which it was thought that the conditions described by Royle might be present, and in both the tibialis posterior was transplanted into the tendo achillis. In one case, at the end of two years, there was no increase in the deformity, and the patient stated that the foot was more comfortable. However, the original deformity was not of the severe type, and there is no assurance that the deformity would have increased, even without the surgery. In the other case, the cavus was not improved, either symptomatically or cosmetically, and it was necessary later to do wedge osteotomies of the tarsus.

During the past year and a half, another type of wedge osteotomy of the tarsus has been used. In this, the wedge, with base upward, is removed from the navicular-cuneiform joints and from the body of the cuboid in conjunction with a stripping of the os calcis. Six feet have been operated upon in this manner by the author, and, while the post-operative periods have not been sufficiently long to draw positive conclusions as to the end results, the author is convinced that it is the operation of choice in cases of this type in which the patient is old enough for bone surgery and the deformity is of the moderately severe variety.

Theoretically and actually, this type of operation has distinct advantages. First, it preserves lateral motion of the foot, and the writer wishes to emphasize again that this motion is of utmost importance in the unparalyzed foot. Second, the site of the osteotomy conforms to the apex of the cavus deformity, which is not true usually when the wedge is removed from the neck of the astragalus. Third, greater correction is maintained, since the fusion on the medial side of the foot is through a joint which has very little to do with lateral mobility.

When the osteotomy is done through the bones on the two sides of the foot—for example, through the neck of the astragalus and through the cuboid—the incongruity of the joints which occurs at the apex remains unchanged, and thus correction is apt not to be as complete or as lasting. This is particularly true of the cosmetic appearance of the foot, because in the relaxed position there is still present a very decided cavus deformity.

This operation, in which the wedge of bone is removed from the navicular-cuneiform joints, has one disadvantage,—namely, sufficient bone cannot be removed to correct adequately the very severe deformities.

### *Group III*

Most of the patients in this group are over fifteen years of age. The cavus deformity is severe, and there is a greater incidence of hammer-toe deformity with disabling and distressing symptoms of the metatarsal arch, and an accompanying varus attitude of the heel is more common.

In the very severe cavus deformity, it is necessary to remove generous wedges of bone, with bases upward, from the mid-tarsal joints in order to flatten sufficiently the longitudinal arch and thereby relieve the painful pressure over the heads of the metatarsals. It is true that this operation

obliterates most, if not all, of the lateral mobility of the foot. Theoretically, there should be a little motion remaining in the subastragalar joint,—namely, that small amount in the tarsal joints distal to the fusion and then transmitted back through the fused area. Actually, motion in the subastragalar joint, following such an operation, is usually nil, and, for this reason, many surgeons are always in favor of including this joint in the operation, in order to increase the fusion area. Experience has shown that there is a tendency for fibrous fusion at the astragalonavicular joint, and, for this reason, inclusion of the subastragalar joint would tend to ensure solid bony union. Of course, if there is a varus deformity of the heel, subastragalar fusion is a necessary part of the operation.

TABLE I  
RÉSUMÉ OF CASES OF TALIPES CAVUS DEFORMITY

Number of patients operated upon		43
Males	25	
Females	18	
Number of feet operated upon		70
Unilateral	16	
Bilateral	27	
Average age		12 years
Average postoperative follow-up		4 years

In these disabling feet, the surgeon must be willing to sacrifice lateral mobility, because the comfort derived by the patient when the weight thrust on the heads of the metatarsals has been decreased more than offsets the loss of motion. The fat pads are worn thin and are frequently covered only by calloused tender skin, and no amount of shoe correction or padding gives any lasting relief.

In these severer deformities, the accompanying hammer toes frequently require surgical correction. As the heads of the metatarsals drop, the dorsal subluxation at the metatarsophalangeal joints increases, concomitant with flexion deformity of the proximal interphalangeal joints.

Tenotomies and capsulotomies alone have proved to be ineffectual in controlling these toe deformities. The improvement gained at surgery is gradually lost. More lasting and gratifying results are obtained by combining these procedures with resection of from one-third to one-half of the distal ends of the proximal phalanges of the second, third, fourth, and fifth toes. This results in a shortening of the toes, which may be of some cosmetic importance, but the relief obtained is so definite that the most exacting patients have no regret.

If the hammer-toe deformity is sufficient to warrant tenotomy, it is better to transplant the tendons of the extensor digitorum longus to the dorsum of the foot into the cuneiform bones, as first described by Hibbs. This permanently does away with the deforming pull of these muscles, and, at the same time, they are converted into efficient dorsiflexors of the foot. This is one transplantation that can be counted upon to give suc-

cess. As soon as the cast is removed, the patient automatically dorsiflexes the foot with the new transplant.

In about one-half of the feet in which this transplantation was done, the tendon of the extensor hallucis longus was transplanted into the shaft of the first metatarsal just behind the head. It would appear that the transplant in this position should have more tendency to lift up the depressed head of the first metatarsal, but, by actual experience, this has not proved to be true; furthermore, the transplant is not as active as it is when inserted more proximally into the cuneiform bones.

Whenever the tendon of the extensor hallucis longus is used as a transplant, regardless of its new insertion, the interphalangeal joint of the great toe should be fused, and the distal end of the cut tendon should be sutured into the extensor hallucis brevis to prevent a distressing flexion deformity of that joint.

In the author's series there were thirty-eight feet in which bone wedges were removed from the mid-tarsal joints. It is always necessary to accompany this operation with a plantar fasciotomy or a Steindler stripping of the os calcis.

#### HEEL-CORD LENGTHENING

So far, no mention of heel-cord lengthening has been made in conjunction with the wedge osteotomies described. In addition to surgery designed to bring the forefoot into proper relation to the hindfoot, it is, of course, necessary to drop the posterior end of the os calcis when the heel cord is too short. This condition may be present in any of the three groups of patients described, but, in the whole series of seventy feet, lengthening of the heel cord was done in only eight cases.

The first impression gained on inspection of a cavus foot is that the heel cord is short. This deceptive appearance may be present even when there is a calcaneus deformity and the heel cord is already too long. There is a too-common tendency to lengthen the heel cord of such a foot without first determining by roentgenograms with the patient standing that such an operation is indicated. Lengthening the tendo achillis when it is not actually short only adds to the cavus deformity. It should be a universal rule that a cavus foot should not be operated upon until roentgenograms with the patient standing have been taken.

#### SUMMARY OF END RESULTS

Plantar fasciotomies in the patients of Group I were somewhat disappointing except in the younger patients with milder deformity. In about half of the cases there was sufficient relapse or progression of the deformity so that further surgery was later indicated. In those cases in which the feet were immobilized for several months with repeated stretchings better results were obtained.

In the patients of Group II wedge osteotomies were done, but the mid-tarsal joints were avoided and thereby lateral motion of the foot was

preserved. In about half of the cases the wedges were removed from the neck of the astragalus and from the body of the cuboid, and in the other half the wedges were removed from the navicular-cuneiform joints and from the cuboid, plus stripping of the os calcis in either case. The latter procedure gave superior results: the cosmetic appearance of the foot was more pleasing; correction was better maintained; and symptoms of the front arch were more uniformly improved.

The severe deformities in the patients of Group III were corrected by wedge osteotomies of the mid-tarsal joints. The cosmetic improvement was uniformly striking, but at least 30 per cent. still had considerable foot discomfort, due partly to the severity of the original deformity and in part to the fact that motion in the mid-tarsal and subastragalar joints had been permanently destroyed by the surgery. It is the author's opinion that better results could be obtained in this Group-III type of patient, particularly those whose deformity is not extreme, by employing the operation in which wedges of bone are removed from the navicular-cuneiform joints and from the body of the cuboid as was done in the patients of Group II. Even though full correction might not be obtained, full mobility of the foot would be preserved.

TABLE II  
TYPES OF SURGERY PERFORMED ON  
FORTY-THREE PATIENTS WITH TALIPES CAVUS DEFORMITIES

Types of Surgery	No. of Feet
Steindler stripping of os calcis or plantar fasciotomy . . . . .	19
Relapse of deformity followed by other surgery later . . . . .	6
Relapse for which other surgery should have been done . . . . .	4
Wedge osteotomies through neck of astragalus and cuboid, plus Steindler stripping operation . . . . .	5
Wedge osteotomies through navicular-cuneiform joints and cuboid, plus Steindler stripping . . . . .	6
Transplantation of tibialis posterior tendon into tendo achillis . . . . .	2
Deformity not controlled and later wedge osteotomy of tarsus required . . . . .	1
Wedge osteotomies through mid-tarsal joints, plus Steindler stripping or plantar fasciotomy . . . . .	38
Second osteotomy later to correct further deformity . . . . .	5
Subastragalar fusion also done . . . . .	6
Transplantation of extensor hallucis longus tendon into first metatarsal and fusion of interphalangeal joint of great toe . . . . .	9
Transplantation of all of the long extensors of the toes into dorsum of foot and fusion of great-toe joint . . . . .	6
Heel-cord lengthening . . . . .	8
Tenotomies and capsulotomies of toes . . . . .	10
Tenotomies and toe capsulotomies, plus resection of distal third or half of proximal phalanx of second, third, fourth, and fifth toes . . . . .	6

## CONCLUSIONS

The examination and study of these seventy surgically corrected feet have been highly instructive, and of help in clarifying certain conceptions and misconceptions regarding the treatment and the care of this deformity.

First, has resulted the conclusion that soft-tissue operations, such as stripping of the os calcis, are of themselves not adequate except in cases of mild deformity in young patients. Likewise, tenotomies and capsulotomies for hammer toes of the severe or the moderately severe variety are disappointing, and the cavus and the concomitant deformities are apt to recur and to progress.

This study also indicates that most of the patients with milder deformity are not treated and watched over for a sufficient length of time. It is believed that better results could be obtained by longer immobilization in plaster, followed by proper shoeing, exercises, stretchings, and, when necessary, repetition of soft-tissue surgery before severe contractures have occurred.

It has demonstrated that adaptive ligamentous contractures and bone deformities occur rather early. In children of only eight or nine years, with slight to moderate deformity, these changes are often present to a degree which makes soft-tissue surgery inadequate.

The lesson has been convincingly brought home that full mobility and lateral motion of the non-paralyzed foot are of fundamental importance. Therefore, fusion of the mid-tarsal joints should be done only in the very severe deformities that cannot be controlled in any other way. Younger children seem to tolerate loss of lateral motion for a time, but later symptoms appear as a direct result of this loss of motion. Once the foot is rigid, it becomes increasingly difficult to employ conservative treatment for relief of pain and discomfort.

This study has emphasized what has been long known, but is sometimes forgotten even by competent surgeons, — namely, while most of these feet have the external appearance of true equinus deformity, the actual deformity is usually only a drop of the forefoot and requires no lengthening of the heel cord. Lengthening of a heel cord which is not short only adds to the original deformity. Cavus feet should never be operated upon until roentgenograms with the patient standing have been taken.

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## TREATMENT OF OSTEOGENIC SARCOMA

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Early amputation is the treatment commonly urged for osteogenic sarcoma of an extremity. Results indicate that early amputation not only is not the best treatment, but it actually tends to assure the death of the patient.

The following is a review of the first 400 cases of osteogenic sarcoma in the Registry of Bone Sarcoma of the American College of Surgeons, cases with inadequate data or seriously disputed diagnosis being excluded. There were 258 cases treated by amputation.

Early amputation is interpreted as amputation within six months of onset of symptoms. Survivors are defined as patients living with no evidence of tumor at the last report more than five years after amputation and the last surgical treatment.

Only 8 per cent. survived early amputation; 29 per cent. survived later amputation. This difference cannot be explained by a lesser degree of inherent malignancy in patients having delayed amputation. Of the patients in whom one or more pathologists thought that histological evidence indicated a lesser degree of malignancy, 14 per cent. survived early amputation, whereas 41 per cent. survived when amputation was delayed. Early amputation was fatal even when malignancy may not have been great.

The same situation obtained with patients in whom one or more pathologists thought that the lesion might be of unusually high malignancy. Of these patients, 4 per cent. survived early amputation, and 37 per cent. survived when amputation was delayed.

Even if cases of possibly low malignancy be completely eliminated from among the late amputations, 24 per cent. of the patients in the remaining cases survived. This result is three times as good as that of early amputation.

Those who think that early amputation is the proper treatment for osteogenic sarcoma of an extremity doubtless expect that the earlier the amputation, the better the result. Such is not the fact. Within the first six months after the onset of symptoms the earlier amputations yielded the poorer results. With amputation in the first month after onset of symptoms, none of thirteen patients survived. With amputation in the second month, one of twenty-five patients survived. In the third month, two of twenty-three patients survived. In the fourth, fifth, and sixth months together, eight of seventy-three patients survived. There is no rational explanation for this, except that very early amputation is fatal.

Of the eleven patients that survived early amputation, all were in the

age period of from eleven to twenty, and all but one had lesions at the distal portion of the femur. Thus, it may be said that, in this series, a patient had practically no chance of survival following early amputation unless he was in the age period of from eleven to twenty and unless the disease was located in the distal portion of the femur. Even at this specific site and in this age period, favorable to early amputation, results were slightly better after late amputation; 21 per cent. survived early amputation, and 25 per cent. survived late amputation.

Radiation before amputation seemed to improve the results of early amputation (23 per cent. surviving), but did not definitely affect the results of late amputation (25 per cent. surviving). Radiation alone did not effect a cure in any case in this series of 400 cases.

Excision before amputation appeared to be a useful treatment. When excision preceded amputation, 17 per cent. survived early amputation, and 29 per cent. survived late amputation. Sixty-seven of the 400 patients were treated by excision with or without amputation. Of these, 28 per cent. survived. The percentage of survival was 35 in cases in which the excision was performed within six months of onset of symptoms and 21 in cases in which it was done later. Of eleven patients treated by excision with no other treatment, 36 per cent. survived; all but one of these four survivors had lesions of possibly low malignancy.

The results of early amputation and those of late amputation were not notably affected by any additional treatments except excision or radiation before amputation, nor were they notably affected by such incidents as biopsy, fracture, or incision and drainage.

When amputation was the only treatment, one of thirty-seven patients survived early amputation, and eight of twenty-one patients survived late amputation.

The results that have been stated appear to be a sufficient indictment of early amputation. Haste to amputate tends to assure the death of the patient. What should be done?

If early amputation is wrong, the best way to treat the early case of osteogenic sarcoma of an extremity is at present unknown. Certain indications of what may prove to be the best treatment have, however, been stated. Mere delay of amputation should improve results. Radiation during the period of delay before amputation should further ameliorate results. Third, it seems probable that excision may be used to advantage before amputation.

In order to make clear the use to which excision may be put, it is necessary to state a theory. The following theory is set forth for that purpose and for no other. The truth or falsity of the theory does not affect the facts that have been stated. The results that are known and the results that will become known by trial will determine the proper treatment of osteogenic sarcoma.

Only eight of the 258 patients upon whom amputations were performed had detectable metastasis before amputation, although many pa-

tients had had the disease for many months or years; yet metastasis regularly became detectable within a few months after amputation. The disease was always ready to produce metastasis when amputation was performed, and amputation was regularly associated with the development of metastasis. This was not true of other incidents which should have a greater tendency to dislodge tumor cells into the blood stream, such as fracture, biopsy, incision, curettage, or excision. Therefore, we cannot assume that metastasis following amputation is principally due to the dislodging of tumor cells into the blood stream at the time of operation.

The following alternative suggests itself. We must assume that tumor cells are discharged into the blood stream more or less constantly in osteogenic sarcoma, and that the disease does not consist solely of a local lesion, but of a local lesion plus innumerable tumor cells circulating in the flowing blood. Usually these free tumor cells die or remain innocuous. Otherwise, there would soon be abundant metastases in all cases. The free tumor cells apparently need some aid to enable them to leave the blood stream and to locate where they can grow. This aid must be offered by the disturbance produced by amputation, but not by other operations, such as biopsy, incision, curettage, or excision. Hence, it appears that the disturbance of the general circulation attendant upon amputation of the extremity is the aid which enables free tumor cells to leave the blood stream and to locate where they can grow in the pulmonary tissues.

After amputation of a leg, the aorta still has blood for two legs, but an outlet only to one. The great veins are in a similar state. There is a considerable disturbance in the circulatory mechanism in adjusting itself to this new state, and this disturbance should be a potent aid in enabling the free tumor cells to leave the blood stream in the lungs.

It is worthy of note that it has often been stated that the more distal lesions appear less malignant than the more proximal lesions. An amputation at the knee or in the mid-thigh causes less disturbance of the general circulation than does a disarticulation at the hip.

The theory that has been stated offers a plausible explanation of the relation of amputation to metastasis. Now, what of the difference between early amputation and late amputation?

We must draw a distinction between the inherent malignancy of the lesion (its capacity to kill quickly, if given the opportunity) and the virility or rapidity of growth of its cells at a given moment. The lesions of osteogenic sarcoma do not grow constantly at an even rate. They have active periods and quiet periods. The cells tend to differentiate more during the quiet periods, but the less-differentiated cells do most of the multiplying in the more active periods. The less-differentiated, actively multiplying cells have the greater capacity to enter the blood stream and require less aid to leave the blood stream in the lungs where they can grow to form metastases.

The early months of osteogenic sarcoma are always an active period

in which amputation regularly results in metastasis. Later, there is at least some chance that the time selected for amputation is a quiet period during which the free tumor cells in the blood stream require greater aid than is offered by the amputation to enable them to leave the blood stream and to locate in the lung tissue. Hence, late amputation offers a better chance of survival than does early amputation, and that chance will undoubtedly become greater when we learn to select a quiet period for amputation,—a time when there has been no sudden increase of pain or of size for at least two months, no recent loss of weight, and when no extensive new development of destruction or soft-tissue mass is visible in the roentgenogram.

The idea that the better results of late amputation might be due to the development of immunity or resistance to the tumor appears to be refuted by the results of excisions. Early excisions yielded much better results than those performed more than six months after the onset of symptoms. Also, of the patients who died following late amputation, one-third were dead within a year after operation; these patients can hardly be said to have developed resistance to the disease.

The theory that has been stated suggests that the proper treatment of osteogenic sarcoma of an extremity should be to find or to create a proper time for amputation and then to amputate. Radiation is useful in creating a proper time for amputation, in that it tends to reduce the more virile cells to a less virile state in which they are less apt to be able to form metastases in the lungs at the time of amputation. Excision may also be useful in creating a proper time for amputation.

The results of excisions in the cases studied have been stated. It should be noted, however, that amputation followed excision in these cases only after recurrence of the tumor was evident. That is not the best use that may be made of excision. The results do not establish what excision can do, but merely show that excision is not harmful.

When osteogenic sarcoma is excised, there is no longer any discharge of tumor cells into the blood stream until such time as recurrence develops, as it almost certainly will. If, after excision, amputation is performed before recurrence is detectable, there will be fewer tumor cells in the blood stream at the time of amputation. If recurrence can be delayed, and if the interval from excision to amputation can be accordingly prolonged, the free tumor cells in the blood stream may die or become so reduced in virility that amputation might be perfectly safe.

Radiation is one means by which the development of recurrence after excision may be retarded; the use of bone chips or grafts at the site of excision is another.

In the few cases in which bone grafts were inserted at the sites of excision of osteogenic sarcomata, the development of recurrence was retarded. There are reasons why this should be so. Bone grafts or chips occupy space which would otherwise be partly occupied by blood clot, and fibrin nourishes or stimulates fibroblastic cells. Also, the inserted bone

stimulates the endothelial leukocytes, the accumulation of which may retard the growth of the tumor cells. In one case, a graft was inserted at the site of excision, and it was thirteen years before another operation was deemed necessary; the patient died two years later.

If, after excision, recurrence is evident before amputation has been performed, a second excision may be done before the amputation. The functional state of the limb after excision is not a serious matter when amputation is to follow.

The treatment recommended for osteogenic sarcoma of an extremity is:

1. Avoidance of early amputation;
2. Delay of amputation;
3. Radiation before amputation;
4. Radiation, excision, and implantation of a bone graft or bone chips before amputation, with amputation following before recurrence becomes evident.
5. Repetition of excision before amputation, if recurrence is evident before amputation has been done.

# UNUNITED FRACTURE OF THE NECK OF THE FEMUR TREATED BY THE AID OF THE BONE GRAFT \*

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In the twenty-six years from July 1913 to June 1939, inclusive, at The Mayo Clinic we have used bone grafts for the treatment of ununited fractures of the neck of the femur in seventy-seven cases. We assumed a fracture of the neck of the femur to be ununited if, at the end of three months following the accident, evidence of repair could not be demonstrated clinically or roentgenographically. In this series, the longest period during which non-union had existed prior to operation was eighty-four months; the shortest period was three months; and the average period was thirteen months. Forty of our patients were males and thirty-seven were females. The oldest patient was sixty-seven years of age, and the youngest was nineteen. In decades of life, the distribution was as follows: sixty to sixty-nine years, five patients; fifty to fifty-nine years, thirty-two patients; forty to forty-nine years, nineteen patients; thirty to thirty-nine years, fifteen patients; twenty to twenty-nine years, five patients; and ten to nineteen years, one patient.

## SELECTION OF CASES

Osteosynthesis with the aid of the bone graft is an ideal way to deal with non-union of the neck of the femur, because anatomical restitution is the aim. However, an operation in which the joint is opened (articular osteosynthesis) is an extensive one and, in unprepared or unskilled hands, it would be attended by a high mortality rate. If any type of bone graft is under consideration, care and sound judgment must be exercised in the selection of patients. Both the general health of the patient and the conditions at the site of fracture are important and must be favorable, if a bone graft is to be used. Sometimes conditions at the site of fracture are satisfactory, but the general health of the patient is not, or *vice versa*. The patient must have a reasonable expectancy of life, and his health must be such that a major surgical procedure will be tolerated. Obese patients are not good subjects. \*

Conditions at the site of fracture which are most important to consider are two:

1. If the head of the femur is necrotic, or if its blood supply is markedly deficient, a bone graft should not be used. However, even with the site of fracture exposed, often fine judgment is required to determine whether the head is sufficiently viable to warrant insertion of a bone graft or whether, instead, the head should be removed and one of the reconstruction operations should be performed. Some poor late results, in which flattening of the head has occurred, can be attributed to lack of viability of the head.

\* Submitted for publication on October 25, 1939.

stimulates the endothelial leukocytes, the accumulation of which may retard the growth of the tumor cells. In one case, a graft was inserted at the site of excision, and it was thirteen years before another operation was deemed necessary; the patient died two years later.

If, after excision, recurrence is evident before amputation has been performed, a second excision may be done before the amputation. The functional state of the limb after excision is not a serious matter when amputation is to follow.

The treatment recommended for osteogenic sarcoma of an extremity is:

1. Avoidance of early amputation;
2. Delay of amputation;
3. Radiation before amputation;
4. Radiation, excision, and implantation of a bone graft or bone chips before amputation, with amputation following before recurrence becomes evident.
5. Repetition of excision before amputation, if recurrence is evident before amputation has been done.

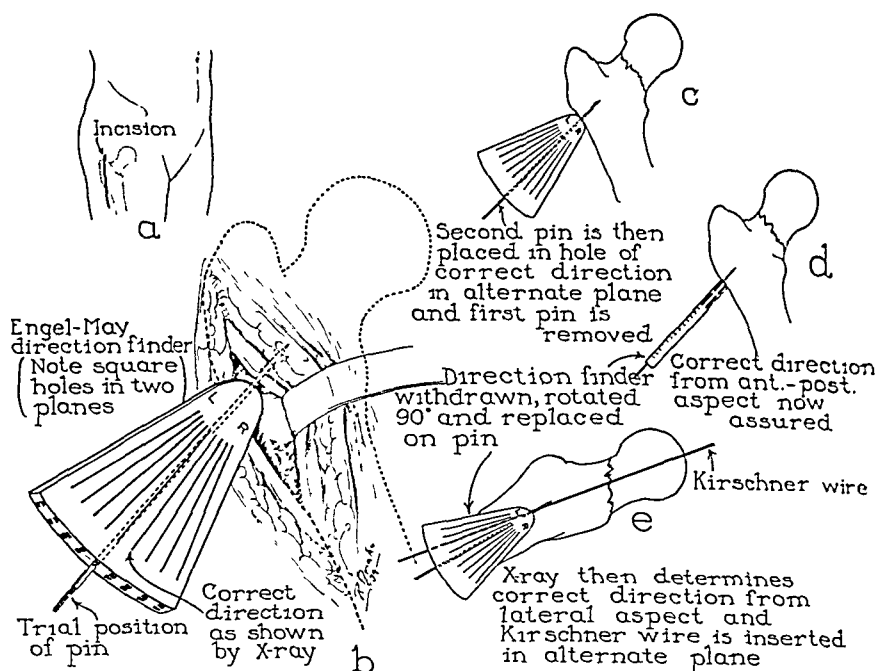


FIG. 2

Method of employment of Engel-May direction finder. Most of the explanation is on the diagram. The holes are in two parallel planes, and the point of the pin has been fixed in the bone sufficiently to hold; another pin can be inserted through a hole in the parallel plane, without its point colliding with the point of the first pin. The holes are square, so that the direction finder can be rotated 90 degrees, and the operations can be repeated in planes at an angle of 90 degrees with the first two planes. The Kirschner guide wire inserted, therefore, will be in the proper direction, both from the anteroposterior and from the lateral aspects.

skin incision made in such a manner that the skin flap can be dissected upward, the trochanteric region can be exposed, and the region of the groin can be excluded from the operative field (Fig. 1, a and c).

2. The capsule is opened and much of it is dissected away, exposing the line of fracture. The fibrous tissue is dissected from between the fragments, and the latter are freshened and fitted.

3. Under visual control, a Kirschner guide wire is inserted into the femur, just below the trochanter, and is thrust up through the neck and into the head. It should be placed sufficiently deep to engage the acetabulum and thus steady the head (Fig. 1, b). A cannulated drill is then sleeved over the wire, and a tunnel, of such a size that the fibular graft will fit snugly, is made well into the head.

4. The bone for the graft is removed (preferably by a second operating team) usually from the fibula of the affected leg. All muscle and periosteum are scraped away, and the cortex is thoroughly freshened with a chisel. This last is an important step, as it enables a blood supply to enter the graft more readily than otherwise.

5. The bone graft is inserted over the wire (Fig. 1, c) and is pounded



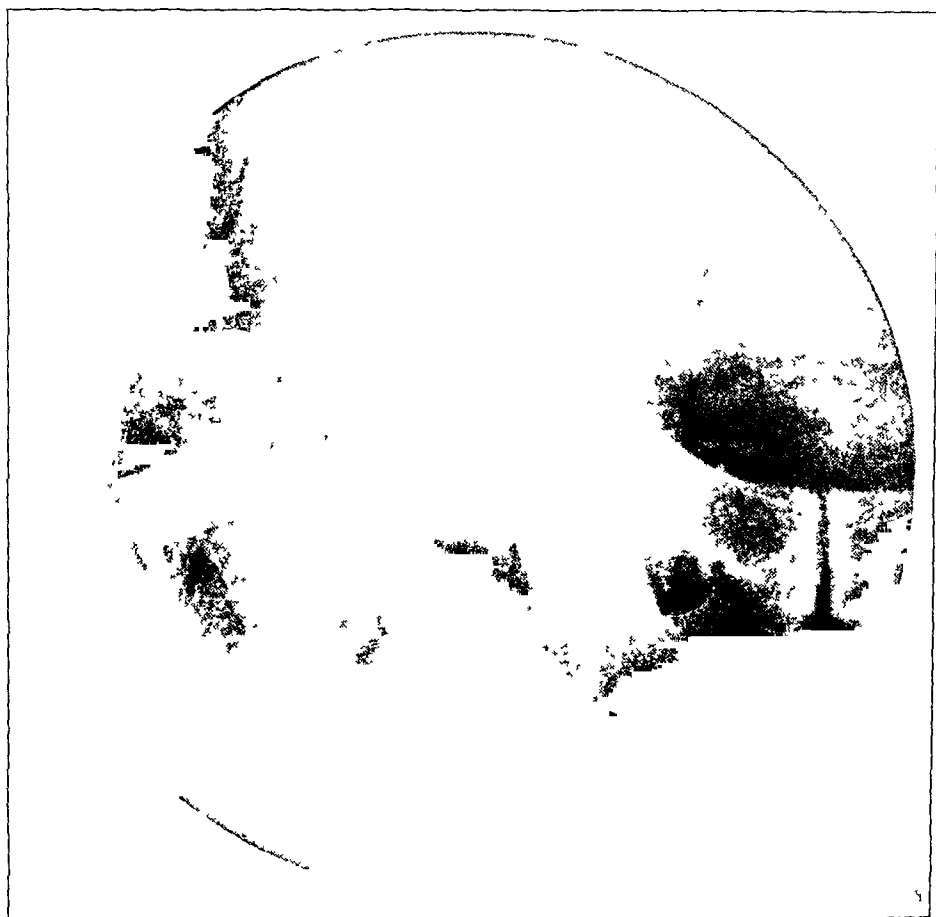


FIG. 3

Fibular bone graft Articular osteosynthesis. Patient was fifty-two years of age, and non-union had existed for more than three years. Roentgenogram represents condition fifteen years after insertion of graft; function was normal.

in to the proper depth (Fig. 1, *d*). The fragments are impacted firmly; then the guide wire is removed.

6. A double spica cast is applied, extending from the toes to the thorax on the affected side and to the knee on the opposite side. It is worn for three months.

7. If the roentgenographic appearance is satisfactory, the patient is allowed to be about on crutches after four months, rarely before. Weight-bearing is not permitted for six months, and preferably not until shadows of bone trabeculae can be seen crossing the line of fracture.

#### *Technique of the Closed Method (Extra-Articular Osteosynthesis)*

The essential preliminaries to this operation, as well as to articular osteosynthesis, are proper alignment of the fragments and obliteration of all shortening, so that the graft will not be subjected to strain or shearing force during the period of healing. Shortening may be overcome by traction, preferably applied in the preoperative period, or, if arthrotomy is



FIG. 4

Fibular bone graft. Extra-articular osteosynthesis. Patient was a woman, sixty-seven years of age, and non-union had existed seven months. Roentgenogram represents end result; there was perfect function fourteen months after operation.

done, it may be combated by dividing the tight structures at operation. The technique of extra-articular osteosynthesis is briefly as follows:

1. A short lateral incision exposes the shaft of the femur just below the trochanter (Fig. 2, a).

2. A Kirschner guide wire\* is inserted a fingerbreadth below the base of the trochanter in such a manner that its longitudinal path through the neck lies below the center of the cross-section of the bone, and its path through the head lies approximately in the center of the cross-section. We have found the Engel-May<sup>1</sup> triangular direction finder (Fig. 2, b, c, d, e) of great aid in inserting the wire †, the control being roentgenograms taken from the anteroposterior and lateral aspects. The placing of many wires in the hope that one finally will be in the correct position is objec-

\* Our standard Kirschner wire is twelve inches long (thirty centimeters) and either two thirty-seconds or three thirty-seconds of an inch in diameter.

† The larger-diameter Kirschner wire is preferable when the Engel-May direction finder is used.

TABLE I  
SUMMARY OF SEVENTY-SEVEN CASES TREATED BY BONE GRAFT

Case	Duration of Non-Union before Operation (Months)	Age (Years)	Sex	Date of Operation	Type of Graft	Result	Date of Last Observation
1	12	49	Male	July 16, 1913	Tibial	Failure	1933
2	3	39	Male	Aug. 20, 1913	Tibial	Union	1917
3	12	53	Male	May 21, 1914	Tibial	Union	1923
4	21	30	Female	Oct. 26, 1914	Tibial	Not traced	
5	22	55	Male	Dec. 4, 1914	Tibial	Union	1915
6	5	51	Male	Dec. 10, 1914	Tibial	Failure	1921
7	10	51	Male	Apr. 20, 1915	Tibial	Failure	1917
8	3	36	Female	Aug. 19, 1915 Apr. 26, 1917	Tibial Fibular	Failure Failure	1921
9	3	46	Male	Aug. 2, 1916	Tibial	Failure	1918
10	12	39	Male	Jan. 11, 1917	Fibular	Failure	1921
11	20	32	Male	May 17, 1917	Fibular	Union	1921
12	13	59	Male	June 14, 1917	Fibular	Failure	1921
13	11	33	Male	July 25, 1917	Fibular	Union	1921
14	5	25	Female	Feb. 28, 1918	Fibular	Failure	1918
15	6	54	Male	Sept. 20, 1918	Fibular	Failure	1920
16	11	53	Female	Apr. 9, 1920	Fibular	Not traced	
17	5	42	Male	Jan. 5, 1920	Fibular	Union	1921
18	10	30	Female	Jan. 6, 1920	Fibular	Union	1936
19	6	53	Male	Apr. 15, 1920	Fibular	Union	1921
20	4½	35	Female	Mar. 12, 1920	Fibular	Union	1924
21	10	37	Male	Sept. 9, 1920	Fibular	Union	1924
22	42	28	Female	Oct. 26, 1920	Fibular	Not traced	
23	22	58	Male	Jan. 17, 1921	Fibular	Union	1938
24	7	52	Female	Jan. 31, 1921	Fibular	Died 2 weeks after operation	
25	8	53	Male	Feb. 23, 1921	Fibular	Union	1925
26	19	21	Male	Mar. 18, 1921	Fibular	Union	1931
27	24	55	Male	Sept. 19, 1921	Fibular	Failure	1929
28	17	35	Male	Nov. 9, 1921	Fibular	Union	1925
29	5½	50	Female	Aug. 17, 1922	Fibular	Union	1938
30	24	40	Male	Mar. 18, 1922	Fibular	Union	1922
31	3	57	Male	June 20, 1922	Fibular	Not traced	
32	5	40	Male	Nov. 3, 1922	Fibular	Failure	1929
33	36	52	Male	Feb. 5, 1923	Fibular	Union	1938
34	27	39	Female	Mar. 19, 1923	Fibular	Union	1925
35	12	32	Male	Sept. 6, 1923	Fibular	Union	1939
36	20	49	Female	Jan. 7, 1924	Fibular	Union	1925
37	9	52	Male	Oct. 7, 1924	Fibular	Union	1925
38	23	44	Female	June 18, 1925	Fibular	Union	1937
39	3	50	Female	May 6, 1926	Fibular	Union	1938
40	18	37	Female	Sept. 30, 1926	Fibular	Union	1937
41	8	21	Female	Nov. 11, 1926	Fibular	Union	1933
42	9	49	Female	Jan. 11, 1927	Tibial	Failure	1929
43	18	42	Male	Nov. 25, 1927	Fibular	Failure	1929
44	13	52	Female	June 21, 1928	Tibial	Union	1934
45	7½	53	Female	Sept. 27, 1928	Tibial	Union	1935
46	6	19	Male	Jan. 14, 1929	Tibial	Union	1929

TABLE I (Continued)

Case	Duration of Non-Union before Operation (Months)	Age (Years)	Sex	Date of Operation	Type of Graft	Result	Date of Last Observation
47	9	48	Male	Feb. 4, 1930	Tibial	Union	1935
48	9	44	Male	Apr. 29, 1930	Tibial	Union	1934
49	8	46	Male	Mar. 31, 1930	Fibular	Union	1934
50	12	54	Male	July 5, 1930	Tibial	Union	1931
51	9	39	Male	Nov. 13, 1930	Tibial	Union	1934
52	22	55	Female	Jan. 16, 1931	Tibial	Failure	1934
53	7	54	Female	Apr. 28, 1931	Tibial	Failure	1933
54	11	48	Female	Jan. 15, 1931	Tibial	Failure	1934
55	21	44	Male	July 4, 1931	Fibular	Union	1936
56	5	38	Female	Aug. 30, 1932	Tibial	Union	1934
57	27	53	Female	Jan. 26, 1934	Tibial	Union	1937
58	25	42	Male	May 28, 1934	Tibial	Union	1935
59	18½	52	Female	June 30, 1934	Fibular	Union	1939
60	5½	46	Female	July 27, 1934	Fibular	Union	1937
61	9	58	Male	Sept. 26, 1934	Fibular	Not traced	
62	23½	42	Female	Jan. 24, 1935	Fibular	Died 3 weeks after operation	
63	5½	56	Female	Dec. 26, 1935	Fibular	Union	1938
64	7	67	Female	June 20, 1936	Fibular	Union	1937
65	6	57	Female	Sept. 25, 1936	Fibular	Union	1938
66	8½	58	Female	Sept. 24, 1936	Fibular	Failure	1937
67	13	51	Male	Oct. 28, 1936	Fibular	Union	1938
68	10	43	Female	Oct. 27, 1936	Fibular	Union	1938
69	10	64	Male	Apr. 6, 1937	Fibular	Union	1938
70	5	50	Male	Nov. 27, 1937	Fibular	Union	1939
71	5	63	Female	July 31, 1937	Fibular	Failure	1939
72	7	67	Female	July 15, 1938	Fibular	Indeterminate	
73	10	52	Female	Sept. 21, 1938	Fibular	Indeterminate	
74	5	28	Female	Oct. 25, 1938	Fibular	Indeterminate	
75	84	49	Male	Jan. 5, 1939	Fibular	Indeterminate	
76	3	57	Female	Jan. 10, 1939	Fibular	Indeterminate	
77	5	62	Female	Apr. 25, 1939	Fibular	Indeterminate	

tionable, for the circulation to the femoral head thus might be so impaired that late atrophy and flattening of bone would develop.

3. Over the wire is sleeved a cannulated twist drill of proper size, and the tunnel for the graft is drilled.

4. The graft is then inserted over the wire and is pounded in to the proper depth. The bone graft must be prepared as described under articular osteosynthesis. The fragments are impacted, and the guide wire is removed.

5. A double spica cast is applied, and the same postoperative care is given as in cases in which articular osteosynthesis is performed.

#### COMMENT

We have used the autogenous massive bone graft,—either a piece of bone taken from the flat internal surface of the tibia (twenty-two cases)

TABLE II  
END RESULTS OF SIXTY-SEVEN BONE-GRAFTING OPERATIONS \*

Year	No. of Operations	End Results		
		Union (Cases)	Failure (Cases)	Death (Cases)
1913.....	2	1	1	0
1914.....	3	2	1	0
1915.....	2	0	2	0
1916.....	1	0	1	0
1917.....	5	2	3	0
1918.....	2	0	2	0
1919.....	0	0	0	0
1920.....	5	5	0	0
1921.....	6	4	1	1
1922.....	3	2	1	0
1923.....	3	3	0	0
1924.....	2	2	0	0
1925.....	1	1	0	0
1926.....	3	3	0	0
1927.....	2	0	2	0
1928.....	2	2	0	0
1929.....	1	1	0	0
1930.....	5	5	0	0
1931.....	4	1	3	0
1932.....	1	1	0	0
1933.....	0	0	0	0
1934.....	4	4	0	0
1935.....	2	1	0	1
1936.....	5	4	1	0
1937.....	3	2	1	0
Total.....	67	46	19	2

\* Of the 78 bone-grafting operations performed on the 77 patients, the end results of 67 operations are known.

or a full segment of the fibula (fifty-five cases). Until recently we have always inserted the bone graft under visual control, the joint being opened (articular osteosynthesis). In the last three years, however, in thirteen of the cases we have not opened the joint, but have employed extra-articular osteosynthesis. Provided shortening and deformity are corrected before operation, we believe that in a case in which good fibrous union exists, a sufficient portion of the neck remains, and the head is viable, extra-articular osteosynthesis is the preferable procedure of the two.

In two instances in which extra-articular osteosynthesis was employed, we used additional metal fixation, hoping thereby to aid the graft. King, of Australia, recently published an article <sup>2</sup> on this phase of the subject. The experience which he reported was chiefly with early cases. His argu-

ment that the use of the nail will permit early movement even in recent fractures is not accepted by Smith-Petersen or by most surgeons in the United States. The placing of a nail, in addition to a bone graft, in a femoral head that already is in subnormal condition may so damage the head that late atrophy and flattening may develop. In our opinion, external fixation should be maintained for three months at least, because that length of time is required for the graft to become solid. Any strain on the graft during that period may cause it to fracture.

Study of the concluding sentence of the first paragraph of this paper and of Table I makes it manifest that bone-grafting operations were not performed on aged patients, for forty of the seventy-seven patients were less than fifty years of age. The average age was forty-six years; whereas, of patients on whom a Whitman reconstruction operation was done in The Mayo Clinic, the average age was fifty-eight years; and, of a smaller group on whom the Colonna type of operation was done, the average age was sixty-one years. In both of these latter procedures, the head is excised, and the upper end of the femur is placed in the acetabulum.

No doubt, if a bone-grafting procedure had been used in an older group of patients, the mortality rate would have been higher than the 2.5 per cent. in this series. The two patients died from postoperative embolism. Perhaps more frequent recourse to extra-articular osteosynthesis will make practical the use of bone-grafting for more elderly patients, particularly if employment of the Smith-Petersen nail, as advocated recently by King<sup>2</sup>, proves feasible. As has been said, we used additional fixation in only two cases, and in those we employed the lag screw, which we think can be inserted with less trauma than is entailed by the nail.

The standard for an excellent result following bone-grafting is much higher than that following other methods (Figs. 3 and 4). Function must be practically perfect. Bony union does not always mean an excellent result; there should be good motion, with little or no limp, and ability to put on the shoe and stocking. Seventy-eight bone-grafting operations were attempted on seventy-seven patients. The end results of sixty-seven of the operations are known (Table II). Forty-six, or 69 per cent., of these operations resulted in union; while nineteen, or 28 per cent., resulted in failure. Two operations (3 per cent.) are excluded from the calculation, because the patients died from postoperative embolism. It is interesting that ten of the nineteen failures occurred in the course of the first six years that bone-grafting was attempted at the Clinic. Our percentage of union was 33.3 for those six years, as compared to 79 for the remaining nineteen years. This emphasizes the importance of experience, resulting in improved technique and proper selection of cases.

#### SUMMARY AND CONCLUSIONS

1. No attempt has been made to compare the bone graft with other methods of treatment for ununited fractures of the neck of the femur. The fact that a review of twenty-six years' work in a large surgical clinic

revealed only seventy-seven cases in which bone-grafting was employed testifies to the caution with which the method has been used. It has, been employed in treatment of about one in ten of the ununited fractures of the neck of the femur encountered.

2. The patients were mostly less than fifty years of age, and the average age was forty-six years, emphasizing the fact that, to the present time, use of the bone graft has been confined to the younger group of patients.

3. The author has presented his findings in this series of cases because there are too few reports on the subject in the literature, and because he believes that, with the improved technique by which the channel for the bone graft is drilled over a guide wire, thus removing the necessity of opening the joint, the field for bone-grafting will be widened.

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# DISLOCATION OF THE ELBOW AND ITS COMPLICATIONS

## A SIMPLE TECHNIQUE FOR EXCISION OF THE ELBOW

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The development of orthopaedic surgery in India has not kept pace with that of other branches of surgery. Fractures and dislocations in South India are still being treated by the crude village bone-setter, with appalling results. This state of affairs affords an unique opportunity for the observation and correction of the conditions resulting from the imperfect or inadequate treatment of elbow dislocations.

Among the 330 cases of elbow injury admitted to the King George Hospital, there were thirty-eight dislocations and one ankylosis, due to smallpox; the latter case is included, as the treatment was the same as that employed in cases of unreduced dislocation. In eight cases the period which elapsed between injury and admission to the Hospital ranged from two hours to twelve days; in thirty cases the interval between injury and admission varied from fifteen days to eleven months. The average interim was two months. Three of the cases of dislocation are not included in this report, as the postoperative interval has not been long enough to permit an accurate estimation of the results.

Most of the dislocations occurred in adults; there were only five cases in which the patients were under fourteen years of age; the youngest patient was nine years old. (See Table I.) There were twenty-nine males and seven females. Of the thirty-five dislocations included in this paper, twelve were of the right elbow and twenty-three were of the left elbow. Most of the dislocations were of the posterior type and in some cases were associated with marked lateral dislocation. In two cases there were fractures of the coronoid process, and in three cases there were associated fractures of the head of the radius. There were no cases of posterior and medial dislocation or of anterior dislocation. Most of the dislocations occurred as the result of indirect violence.

The treatment of elbow dislocation, when the patient is seen immediately after the accident, is simple, provided the following principles are observed:

1. Roentgenographic examination before reduction and preliminary investigation for nerve injuries.
2. Reduction of the dislocation under anaesthesia and a second roentgenographic examination after reduction.
3. Proper splinting of the dislocation after reduction to prevent effusion into the joint and the surrounding tissues.
4. Enforcement of sufficient rest to permit the completion of the



TABLE I  
ANALYSIS OF THIRTY-SIX CASES OF ELBOW INJURY

Case No.	Sex	Age (Years)	Injury		Date	Duration	Treatment	Result	
			Type	Side				At Discharge	Follow-Up in 1938
1	Male	12	Posterolateral dislocation with separation of lateral epicondyle	Left	1930	12 days	Reduction under general anaesthesia and immobilization in plaster for 14 days	Good	No reply to letter
2	Male	17	Posterolateral dislocation with separation of medial epicondyle into joint and primary ulnar-nerve involvement	Left	1930	24 hours	Reduction under general anaesthesia Operation to explore ulnar nerve and to reduce fracture of condyle advised but refused	Flexion to 50 degrees Extension to 100 degrees Ulnar-nerve palsy	No reply to letter
3	Female	10	Posterior dislocation	Right	1930	24 hours	Reduction under general anaesthesia and immobilization in plaster in flexed position for 2 weeks	Good	No reply to letter
4	Male	20	Posterior dislocation	Left	1931	1 day	Reduction under general anaesthesia and immobilization in plaster in flexed position for 2 weeks	Very good	No reply to letter
5	Female	16	Posterior dislocation with flake fracture of coronoid process	Left	1931	1 day	Reduction under general anaesthesia and immobilization in plaster for 2 weeks	Very good	Elbow normal
6	Male	40	Dislocation reduced immediately elsewhere Fracture of coronoid process on admission	Right	1933	8 days	Immobilization in plaster in flexed position for 1 week	Good	Very good
7	Male	18	Posterior dislocation with fracture of head of radius	Left	1934	2 hours	Reduction under general anaesthesia and immobilization in plaster	Very good	Could not be traced
8	Male	45	Posterolateral dislocation with crack fracture of head of radius	Left	1936	4 hours	Reduction under general anaesthesia and immobilization in plaster for 2 weeks	Very good	Very good function
9	Male	30	Posterior dislocation treated by bone-setter Persistent dislocation and new-bone formation on admission	Right	1930	3 months	Excision advised but refused		
10	Female	30	Posterolateral dislocation treated by bone-setter Persistent dislocation and new-bone formation on admission	Right	1931	3 months	Excision advised but refused		

12	Male	25	Fixation and marked new-bone formation on admission	Left	1931	2 months	months and later excision advised but refused	No reply to letter
13	Male	15	Dislocation treated by bone-setter Fixation and new-bone formation on admission	Left	1931	2 months	Rest in plaster for 2 months and later excision advised but refused	No reply to letter
14	Male	30	Dislocation treated by bone-setter Marked new-bone formation on admission	Right	1932	25 days	Under general anaesthesia elbow flexed to right angle and immobilized in plaster	No reply to letter
15	Male	30	Dislocation reduced by doctor Inability to move elbow and bone thickening on admission	Left	1935	20 days	Transferred to medical service and died of heart failure	
16	Male	19	Dislocation treated by bone-setter Unreduced dislocation and beriberi heart on admission	Left	1930	6 weeks	Elbow flexed under general anaesthesia and immobilized in plaster for 3 months Excision of new bone after removal of plaster	No reply to letter
17	Male	30	Dislocation reduced by doctor after treatment by bone-setter Fixation and new-bone formation on admission	Left	1930	2 months	Attempted flexion under anaesthesia failed Plaster immobilization for 1 month Excision of new bone Excision of new bone under general anaesthesia	Fixation
18	Male	14	Dislocation treated by bone-setter Fixation and new-bone formation on admission	Right	1930	6 months	Good	No reply to letter
19	Male	12	Dislocation treated by bone-setter Fixation and marked new-bone formation on admission	Right	1936	11 months	Good	Elbow normal
20	Male	9	Dislocation treated by bone-setter Fixation and incomplete division of median nerve	Left	1931	20 days	Open reduction under general anaesthesia	No reply to letter
							Very little motion Flexion to 60 degrees Extension to 80 degrees Median nerve improved	

TABLE I (Continued)

Case No.	Sex	Age (Years)	Injury			Treatment	Result	
			Type	Side	Date	Duration	At Discharge	Follow-Up in 1938
21	Male	10	Dislocation treated by bone-setter Fixation and marked new-bone formation	Left	1932	1 month	Open reduction under general anaesthesia	Very little motion Flexion to 40 degrees Extension to 60 degrees No reply to letter
22	Male	43	Dislocation treated by bone-setter Fixed unreduced dislocation on admission	Left	1931	15 days	Closed reduction under general anaesthesia tried. Ulna broke, permitting flexion. Limb kept in flexion until fragments united.	Good (an example of Thomas's false reduction) No reply to letter
23	Male	34	Dislocation treated by bone-setter Fixed unreduced dislocation on admission	Left	1931	3 months	Closed reduction under general anaesthesia tried without success	Poor No reply to letter
24	Male	45	Dislocation treated by bone-setter Fixed unreduced posterior dislocation on admission	Left	1931	1 month	Arthroplasty under general anaesthesia Limb flexed and immobilized in plaster for 10 days	Flexion to 60 degrees Extension to 120 degrees No reply to letter
25	Male	30	Dislocation treated by bone-setter Fixed unreduced posterior dislocation on admission	Left	1933	1 month	Excision under brachial anaesthesia, using Langenbeck's incision Limb in flexion for 10 days, followed by active motion with collar-and-cuff splint	Flexion to 60 degrees Extension to 130 degrees (Patient did not cooperate when active motion was advised) No reply to letter
26	Male	30	Dislocation treated by bone-setter Fixation and marked new-bone formation on admission	Left	1934	5 months	Excision under brachial anaesthesia, using Langenbeck's incision Further treatment as in Case 25	Flexion to 60 degrees Complete extension Movements limited
27	Male	40	Dislocation treated by bone-setter Fixed unreduced dislocation and new-bone formation on admission	Right	1934	1 month	Excision under brachial anaesthesia, using Langenbeck's incision Further treatment as in Cases 25 and 26 (Patient left Hospital during treatment)	Flexion to 70 degrees Extension to 120 degrees No reply to letter
28	Female	20	Dislocation treated by bone-setter Unreduced dislocation on admission	Right	1935	2 months	Excision under brachial anaesthesia Skeletal traction by Kirschner wire through the lower end of radius and ulna for 2 weeks	Flexion to 40 degrees Extension to 165 degrees Very good (can lift heavy weight)

29	Male	19	Dislocation treated by bone-setter Unreduced dislocation on admission	Left	1935	34 days	Excision under brachial anaesthesia Further treatment as in Case 28	Good (1937) Flexion to 50 degrees Extension to 150 degrees
30	Male	20	Dislocation treated by bone-setter Unreduced dislocation and new-bone formation on admission	Right	1937	3 months	Excision under brachial anaesthesia Further treatment as in Case 28 (Patient left Hospital during treatment)	Fair Flexion to 70 degrees Extension to 130 degrees
31	Male	30	Dislocation treated by bone-setter Fixation and new-bone formation on admission	Left	1937	3 months	Excision under brachial anaesthesia Further treatment as in Case 28	Normal function
32	Female	30	Dislocation treated by bone-setter Fixation and marked new-bone formation on admission	Left	1937	2 months	Rest in plaster-of-Paris for 3 months Excision under brachial anaesthesia Further treatment as in Case 28 Radial paralysis, due to contusion of nerve, necessitated passing of ulnar nerve through bone tunnel with recovery in 2 months	Patient has useful elbow and can lift heavy weights Extension limited by 20 degrees
33	Male	30	Dislocation treated by bone-setter Unreduced dislocation on admission	Left	1937	11 months	Excision under brachial anaesthesia Further treatment as in Case 28	Normal function
34	Female	32	Dislocation treated by bone-setter Fixation, fracture of head of radius, and new-bone formation on admission	Right	1937	5 months	Excision of head of radius under general anaesthesia and rest for 4 months Excision of elbow under general anaesthesia Further treatment as in Case 28	Very good
35	Male	20	Fixation of elbow as result of smallpox X-ray showed fusion of ulna to lower end of humerus	Right	1937	11 years	Excision under brachial anaesthesia Further treatment as in Case 28	Good function
36	Male	25	Dislocation treated by bone-setter Fixation and new-bone formation on admission	Right	1937	8 months	Immobilization in plaster for 2 months Excision under brachial anaesthesia Further treatment as in Case 28	Good function



FIG. 1-A

FIG. 1-B

Case 28. Persistent posterior dislocation of right elbow.

process of healing inside the joint.

5. Institution of graduated active exercises with physiotherapy after removal of the splints to restore function.

It has been the routine practice in this Hospital to reduce a recent dislocation of the elbow under general anaesthesia. After reduction, the elbow is immobilized in flexion,



FIG. 2

Case 28. After excision.

with the forearm in supination, in plaster-of-Paris for a fortnight. At the end of that period, the plaster-of-Paris is removed, and active movements and massage are instituted. After the conclusion of the exercises, the elbow is always rested in flexion in a Jones collar-and-cuff splint. When movements are quite free and painless, the splint is discarded. Eight patients were treated by this method, and the postoperative follow-up showed very good results.

The principle of this treatment is based on the aseptic healing of wounds in connective tissue. It is well known that the granulation tissue which is formed in the healing of aseptic wounds is ultimately converted into fully formed fibrous tissue in a fortnight's time. In dislocations, as the result of tearing of the ligaments and the blood vessels, hemorrhage occurs, and, when this organizes, it is replaced by granulation tissue, which ultimately is converted into fibrous tissue. In the region of the elbow, if the granulation tissue is not allowed to consolidate into fibrous

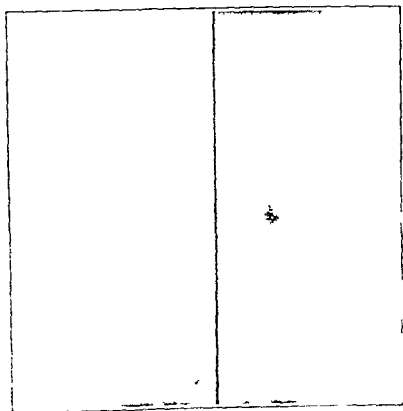


FIG. 3-A

FIG. 3-B

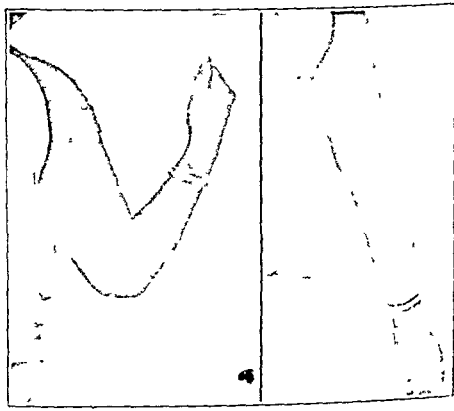


FIG. 3-C

FIG. 3-D

Case 28. Roentgenograms and photographs showing the function of the elbow one and one-half years after excision.

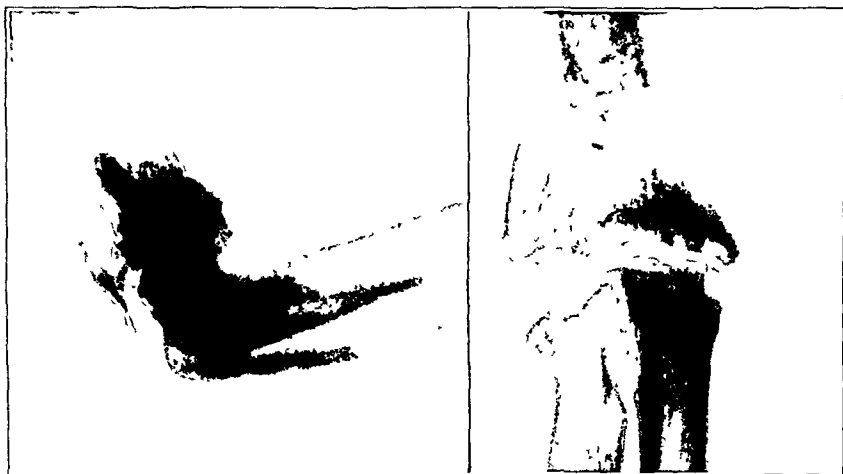


FIG. 4-A

FIG. 4-B

Case 28. Lateral and anteroposterior roentgenograms three years after excision.

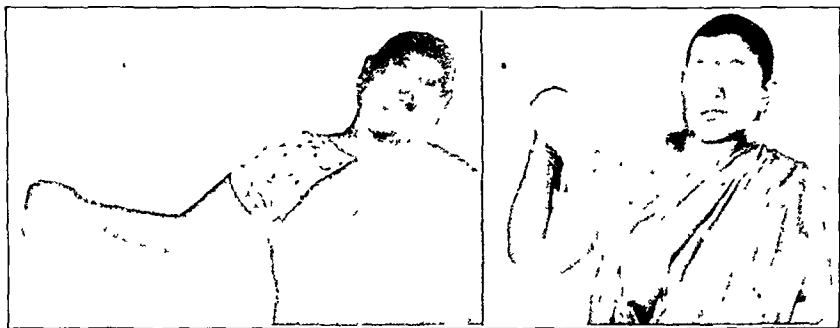


FIG. 5-A

FIG. 5-B

Fig. 5-A and Fig. 5-B: Case 28. Photographs showing the weight-bearing capacity of the elbow with the arm in abduction at the shoulder and with the forearm in supination.

Fig. 5-C: Case 28. Photograph showing the scar and the extension of the elbow.



FIG. 5-C

tissue, it may be the starting point of new-bone formation (the pre-osseous substance of Leriche and Policard). This transformation of granulation tissue into bone is possible because of the common origin of all connective tissue from one mesenchymal stem. It is necessary, therefore, to rest the elbow completely for a fortnight until the fibrous tissue is fully formed before active movements are begun. In cases where this principle was ignored, new bone (myositis ossificans) developed in front of or behind the elbow, or in both locations, causing limitation of movement or fixation of the elbow. Most of the cases of

dislocation of the elbow that were treated by bone-setters and, in a few instances, by medical practitioners were subjected to forced movements, with the resulting formation of new bone (myositis ossificans) and limitation of motion.

### COMPLICATIONS

Various complications may occur after dislocation of the elbow, but the following were the most common in this series: (1) nerve injury (two cases); (2) myositis ossificans (fourteen cases); and (3) unreduced dislocations resulting in fixation of the elbow with or without new-bone formation

and marked deformity (twelve cases). The majority of these complications were due to ignorance on the part of the patient and the lack of proper medical care.

The treatment of complications such as unreduced dislocations or myositis ossificans presents a difficult problem. Open reduction was practised in only two cases of unreduced dislocation of twenty days' and one month's duration, respectively, in children (Cases 20 and 21), with unsatisfactory results. In two cases of old unreduced dislocation



FIG. 6-A

FIG. 6-B

Fig. 6-A: Case 32. Left elbow, showing marked new-bone formation in front of and behind the elbow. Note the lamination, the posterior aspect of which is attached to the lower end of the humeral diaphysis and the upper end of the radius.

Fig. 6-B: Case 32. After excision.

(Cases 22 and 23), in which operation had been refused, closed reduction under general anaesthesia was done. In one of these cases (Case 22), as a result of manipulation, a fracture of the ulna occurred an inch below the coronoid process, permitting flexion of the elbow from the fixed extended position. This flexion was maintained in a plaster-of-Paris splint until the fracture had united. The result was quite satisfactory, as the functional range of motion was a definite improvement. This is an example of Thomas's false reduction. In the other case, the result was not satisfactory.

In the treatment of myositis ossificans, excision of the new bone, after sufficient time for consolidation has been allowed, has been advised.



FIG. 7-A



FIG. 7-B



FIG. 7-C



FIG. 7-D

Case 33. Serial photographs showing the method of after-treatment following excision.

Fig. 7-A: Extension in a Thomas arm splint with Kirschner-wire skeletal traction.

Fig. 7-B: Amount of active flexion obtained with support on removal of Kirschner-wire extension fourteen days after excision. Note the method of plaster splinting.

Fig. 7-C: Amount of flexion obtained two days later. Note method of splinting.

Fig. 7-D: Active flexion obtained on seventh day after removal of Kirschner wire.

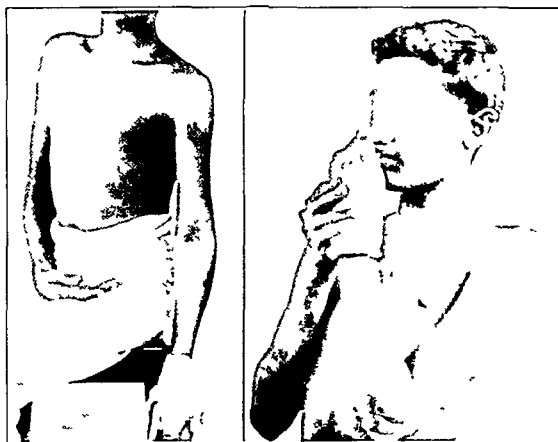


FIG. 7-E

FIG. 7-F

Fig. 7-E and Fig. 7-F: Amount of active extension and flexion obtained before discharge. The patient had slight radial paralysis and so a small cock-up splint was used. The paralysis disappeared in a month's time.

In the majority of the cases the new bone was adherent to the lower end of the humeral diaphysis above or to the olecranon, coronoid process, or head of the radius below. In such cases excision has not given satisfactory results, except in two cases (Cases 18 and 19), in which the new



bone was attached to one end of the diaphysis by a well-developed pedicle and was free from any other attachment.

Arthroplasty of the elbow is an excellent method of treatment and was done in one case (Case 24). This procedure was not repeated in other cases because of the difficulty of developing a team with perfect aseptic technique to cooperate in the removal of fascia lata in order to minimize the operative time, as most South-Indian patients do not stand prolonged operation. In arthroplasty, administration of a general anaesthetic is necessary, which adds to the shock of operation.

The simplest method of operative intervention to restore the movements of the elbow is a properly designed excision, which gives the same satisfactory results as does arthroplasty, and the author has used the following technique with success.

#### OPERATIVE TECHNIQUE

Through Langenbeck's incision, sufficient bone from the lower end of the humerus and the upper end of the ulna is excised to produce a gap of at least one and one-half inches. The bones are shaped to resemble the normal articular ends and are smoothed by a file. To keep the bone ends apart, skeletal traction from the lower end of the radius and of the ulna is obtained by Kirschner wire. After a firm bandage has been applied to the elbow to prevent effusion, the limb is put in extension in a Thomas arm splint for a fortnight. At the end of a week, the stitches are removed without disturbing the traction; at the end of a fortnight, the Kirschner wire is removed, and active flexion with slight support is encouraged. On the first day, active flexion to 160 degrees is usually obtained. To prevent effusion as a result of this movement, the elbow is supported in a plaster-of-Paris cast. This method of active flexion is repeated from day to day until flexion of from 45 to 50 degrees is obtained. When this stage has been reached, active movements with physiotherapy are started to restore the normal function of the muscles controlling the elbow joint, which, as the result of disuse, have generally atrophied. The elbow is always rested in flexion by a collar-and-cuff splint. In about two months' time the power to flex and to extend the elbow against resistance is easily restored, and the patient is discharged to carry on the treatment at home.

#### END RESULTS

To evaluate the success of this treatment, it is necessary to test the results from two standpoints: (1) the cosmetic effect; (2) the weight-lifting capacity. An elbow which moves freely following excision does not necessarily have good function; this was found to be true in some cases in which the patients sought advice for disability after excision of the elbow elsewhere. The following tests for function should be conducted:

1. Flexion and extension without weight, with the arm by the side and the forearm in supination.
2. Flexion and extension without weight, with the arm abducted at

# THE NICOLA OPERATION: A SIMPLIFIED TECHNIQUE

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In 1929 Nicola<sup>3</sup> reported a new operation for recurrent anterior dislocation of the shoulder. The excellence of his procedure is attested by its widespread adoption without appreciable modifications or changes in principle. The details of the operation are well known and need no further comment here. Other writers<sup>1,6,8</sup> and Nicola in his follow-up reports<sup>4,5</sup> have emphasized the importance of the proper placing of the tunnel through the humerus and have explained the necessity of fixation of the tendon in the tunnel. To assure proper fixation of the tendon throughout the tunnel, it is desirable to have bony contact with the tendon

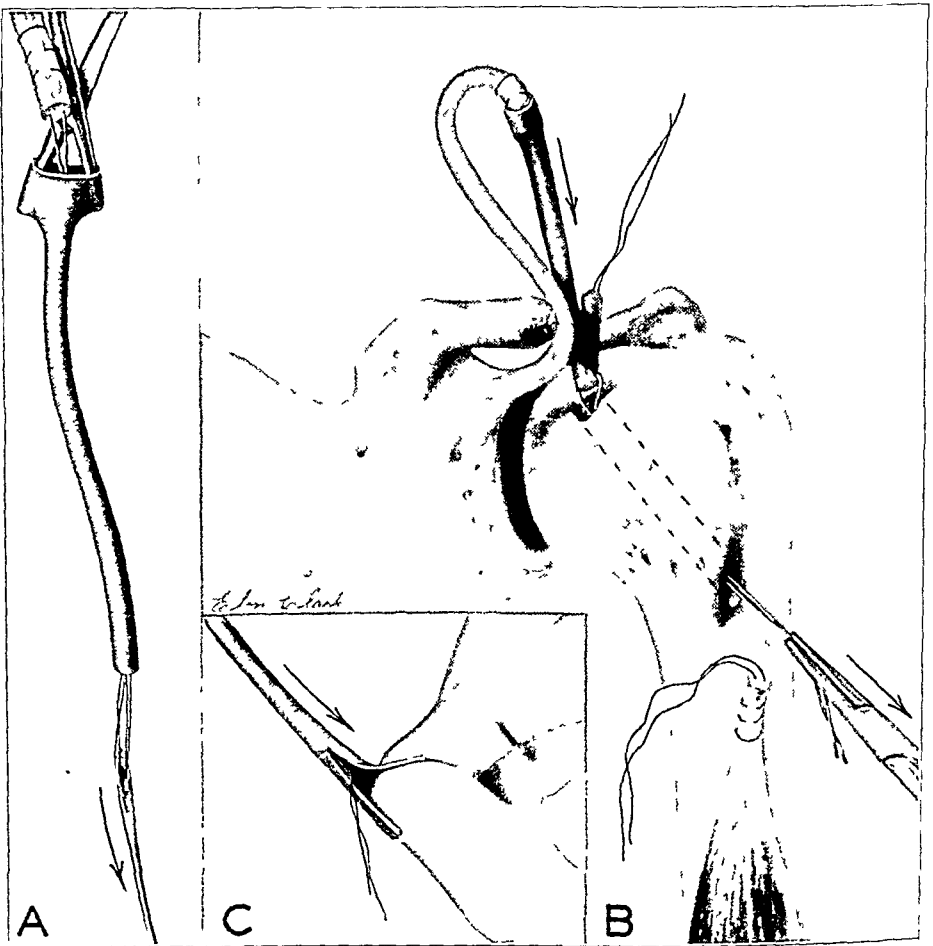


FIG. 1

A: A probe has been passed through a piece of Dakin tubing, and the stay suture has been threaded through the probe and pulled through the tubing by the probe. The mouth of the tubing has been dilated with a hemostat to receive the distal end of the proximal portion of the tendon.

B: A hairpin, made of silver wire, has been passed through the bone tunnel, and the tubing containing the stay suture has been threaded through the loop of the wire before being pulled through the tunnel.

C: The distal end of the tubing has been split to facilitate its removal without traction on the tendon and the suture.

throughout the tunnel. Proper contact is secured by making the diameter of the tunnel approximately the same as that of the tendon.

In carrying out the operation, the writer has followed the technique as outlined by Nicola, but has frequently experienced difficulty in getting the cut end of the proximal portion of the tendon started into the tunnel, due to its jamming as it is pulled against the mouth of the tunnel by the stay suture. To avoid this difficulty without having to enlarge the diameter of the tunnel, a modification in the technique, as illustrated in the accompanying drawings, has been tried and found most satisfactory. After the biceps tendon has been severed, the stay suture in the proximal portion of the tendon is threaded through a piece of Dakin tubing, three millimeters in diameter and fifteen centimeters long, as illustrated in Figure 1, A. The mouth of the tubing is dilated with a hemostat to allow the end of the tendon to enter the tubing for a distance of about one-half a centimeter. A silver wire, twenty-five centimeters long and bent as a hairpin (Fig. 1, B), is used as a guide through the tunnel. The wire is preferred to a probe, flexible aneurysm needle, tonsil snare<sup>2</sup>, or flexible needle<sup>7</sup>, as it is as serviceable as any of the other instruments and is more adjustable to the needs of each case. The tubing with the enclosed stay suture is moistened with normal saline solution, threaded through the loop in the silver wire, and pulled through the tunnel. The tubing, which is thin-walled (one millimeter), is elastic and easily compressed; it serves to guide the end of the tendon into the tunnel and eliminates the need of undue force and strain on the stay suture. After the tendon has been delivered through the distal end of the tunnel, the tubing can be rolled off the tendon, and the suture can be pulled free. The author has found that splitting the distal end of the tube about two centimeters (Fig. 1, C) facilitates grasping the tube and avoids traction on the stay suture. The remainder of the operation and the convalescent care are carried out as outlined by Nicola.

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# THE SURGICAL TREATMENT OF ACUTE SUBACROMIAL BURSITIS

BY WILLIAM P. BARTELS, M.D., HEMPSTEAD, NEW YORK

Acute subacromial bursitis has long been considered a purely medical problem. The results in a series of thirty-three cases of acute subacromial bursitis treated by open operation during the past two and one-half years have convinced the author of the very definite value of surgery in effecting a more prompt and certain cure of the condition.

Good roentgenograms of the affected shoulder, taken with the arm in internal and in external rotation, will demonstrate calcified deposits about the tuberosities of the humerus in 90 per cent. of the cases. When acute subacromial bursitis and tendinitis are associated with calcified deposits, there is present a condition that will respond dramatically to surgical treatment. If surgery of the type to be described is performed immediately and properly, the patient can be assured of relief from severe pain within twenty-four hours and of the return of from 60 to 90 per cent. of function of the shoulder and of the extremity at the end of three weeks.

The operation for removal of bursa and calcified deposit is simple and takes from fifteen to twenty-five minutes under general anaesthesia. A three-inch incision, from the anterior edge of the acromion downward, is made. The deltoid is split in the direction of its fibers. The oedematous roof and walls of the subacromial bursa are dissected out and excised. Cloudy fluid and, infrequently, a calcified plaque may be found in the bursa. The tendons of insertion of the supraspinatus, the infraspinatus, and the teres minor, as well as the tendon of the subscapularis, are examined for calcified deposits by making small incisions in the direction of the tendon fibers. These deposits are usually multiple and vary in size from a pinhead to a lima bean. They may be buried in the tendon substance or they may extensively replace the tendon fibers by causing necrosis, in which case they are easily seen. Good roentgenograms of the shoulder, taken with the arm rotated in different positions, must be at hand for convenient consultation during the operation. Thorough removal of all the calcified material is essential, if the operation is to succeed in permanently relieving the patient. The removal is effected by a curette, followed by sharp excision of infiltrated tendon fibers. No sutures are needed to close the small incisions made in the tendons. The deltoid muscle is loosely approximated, and the skin is closed with interrupted sutures so placed as to allow seepage from the wound in the first twelve hours after operation. No splint or retentive device is used.

Postoperative treatment consists in making the patient comfortable by the use of morphine for the first twenty-four hours, after which codeine is usually sufficient. The patient's former intense pain has disappeared

by the day after the operation. The patient is allowed out of bed on the second day and is encouraged to use the extremity. Movement of the shoulder at frequent intervals is demanded; preferably, the patient stands with the trunk bent forward from the hips, allowing the arm to swing freely from the shoulder like a pendulum.

During the past two and one-half years, thirty-three cases of acute subacromial bursitis have been treated by open operation by Dr. Otho Hudson and the author. In this series there were twenty males and thirteen females. The average age was forty-two years; the youngest patient was thirty-two and the oldest, fifty-seven. The right shoulder was opened in twenty-two cases and the left, in eleven cases. A history of strain or contusion prior to onset of severe pain was obtained in about 50 per cent. At operation, which was always done under general anaesthesia, calcified deposits were found and removed in thirty-one instances. The approximate locations of the deposits were as follows: greater tuberosity, twenty-two cases; both greater and lesser tuberosities, nine cases. The length of the hospital stay averaged three days. Immediate relief of acute pain was obtained in all but one patient. When this patient was x-rayed postoperatively, it was found that a large calcified deposit had been overlooked at the time of operation. All wounds healed *per primam*. No postoperative complications occurred. The results were excellent in thirty-one patients, who had practically complete abduction and were able to perform all their usual work within eight weeks. In two patients poor results were obtained. One of these patients had a recurrence of pain at the end of two weeks. This patient had an acute bursitis without any demonstrable calcified deposit, but with an associated tendinitis about the shoulder, which continued to remain active for about five months after operation, and eventually stretching of the shoulder was necessary to secure motion. The other poor result occurred in a workman, who refused to have his abscessed teeth extracted after operation. This patient also developed a myofascitis about the shoulder. Marked limitation of motion ensued. No recurrences have been noted after removal of the deposit by surgery.

#### CONCLUSION

The surgical treatment of acute subacromial bursitis is simple, safe, and dramatically effective in relieving pain and in permitting return of full function in the shortest possible time.

## A NEW APPROACH TO THE WRIST JOINT \*

BY M. N. SMITH-PETERSEN, M.D., BOSTON, MASSACHUSETTS

This seems rather an ambitious title, and it is quite possible that in the course of time it may be shown that this approach is not at all new. A very thorough search of the literature has been made, and no reference to this particular way of exposing the wrist joint has been found.

In 1936 Dr. William Darrach<sup>1</sup> published an article in the Jubilee Volume of Dr. Lambotte on "Resection of the Distal Portion of the Ulna in Cases of Derangement of the Inferior Radio-Ulnar Articulation". He carried out this procedure for the first time in 1910, and, since then, has employed it for many different conditions with great success. Dr. Darrach's work made it possible for the author to conceive the idea of using the exposure obtained by the resection of the distal portion of the ulna for radiocarpal arthrodesis.

In arthrodesing the wrist, we aim to produce a fusion of the radiocarpal joint in the optimum position of dorsiflexion and—this is most important—to preserve the motions of pronation and supination. Dr. Dar-

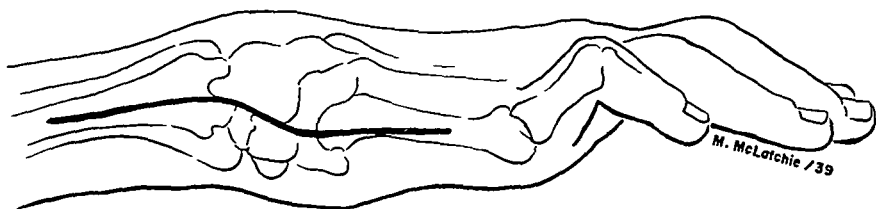


FIG. 1

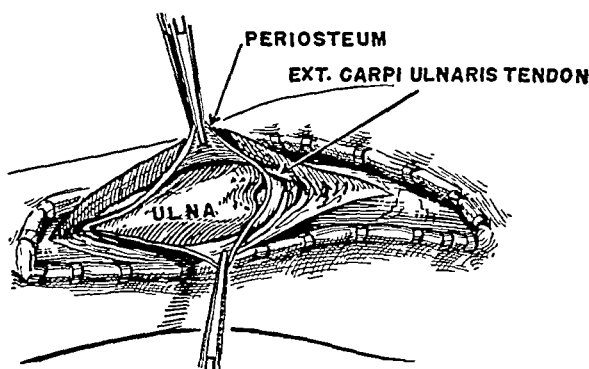


FIG. 2

rach has given us the answer: By resecting the distal inch of the ulna, interference with pronation and supination is eliminated, and this very procedure also adequately exposes the radiocarpal joint. In any operation, so planned that adequate exposure is obtained, the local procedure is usually successful; in any

operation in which inadequate exposure is obtained, the local procedure usually results in failure or in limited success in the majority of cases.

The incision (Fig. 1) starts two or two and one-half inches above the

\* Read at the Annual Meeting of the American Orthopaedic Association, Buffalo, New York, on June 7, 1939.

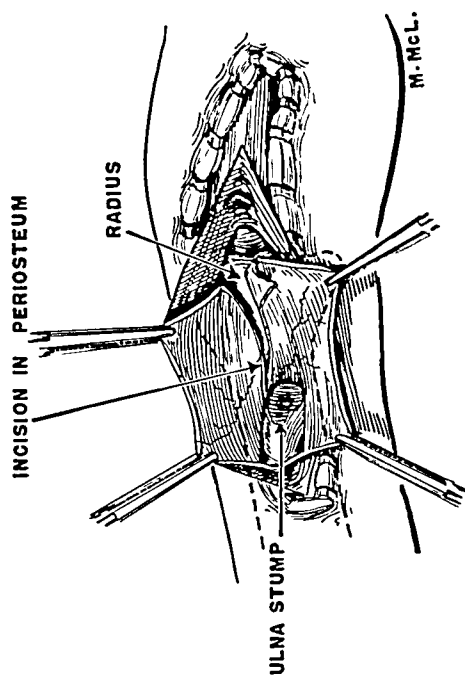


Fig. 3

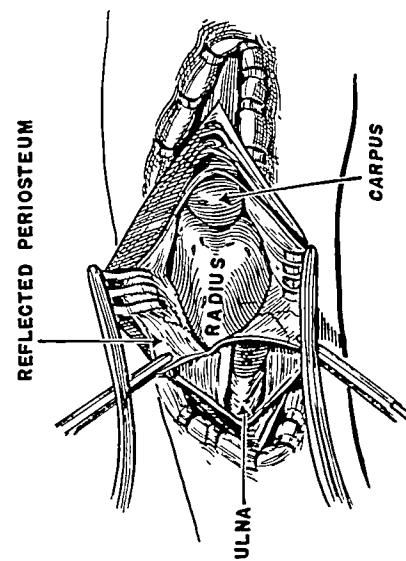
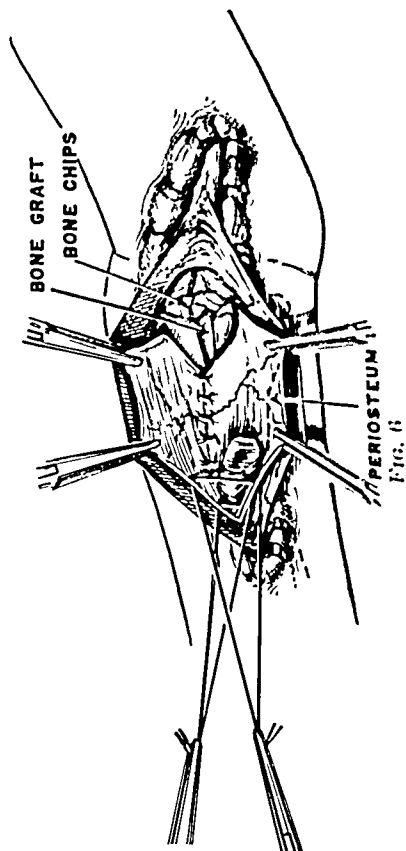


Fig. 5

Fig. 4



ulnar styloid, running parallel with the ulna to a point just distal to the styloid; it then curves anteriorly in the direction of the proximal end of the fifth metacarpal; the distal portion runs parallel with this bone for a distance of approximately one inch. A bayonet incision of this type results in two flaps, which are easily retracted. Since the incision is over the ulnar aspect of the wrist, the resulting scar is out of sight most of the time.

By a division of the subcutaneous fat and fascia, the ulnar periosteum is exposed and incised (Fig. 2). If the surgeon is not in too much of a hurry, a true subperiosteal exposure of the ulna can be obtained.

Following an oblique osteotomy, the distal inch or so of the ulna is removed, exposing the ulnar aspect of the radius (Fig. 3). The capsule and the ligaments are reflected from the radius along with the periosteum of the latter, exposing the radiocarpal joint (Fig. 4). The same procedure is carried out distally, reflecting capsule and ligaments from the carpus. The increased mobility thus obtained facilitates the complete removal of the cartilage from the radius and the carpus (Fig. 5). With the hand in the optimum position of dorsiflexion, slots are cut in the radius and the carpus, into which the graft is sunk (Fig. 6). As a rule, the excised portion of the ulna, properly shaped, makes an efficient graft; the remaining fragments are packed around the volar aspect of the graft.

#### CONCLUSIONS

The approach to the wrist joint which has been described is particularly applicable to cases in which an arthrodesis of the radiocarpal joint is indicated, without interference with pronation and supination.

By extending the incision distally, it may be applied to any condition demanding exposure of the proximal or of the distal rows of carpal bones.

1. DARRACH, WILLIAM: *In Libre jubilaire offert au docteur Albin Lambotte par ses amis et ses élèves*. Brussels, Vromant & Co., 1936.



# LOCK-BOLT FIXATION OF FRACTURES OF THE FEMORAL NECK AND OF INTERTROCHANTERIC FRACTURES

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In treating femoral-neck fractures, we undertake fixation as soon as the patient has recovered from the primary shock of injury. Russell traction is used as a preliminary measure, but it is maintained only so long as is absolutely necessary, since procrastination invites such complications as bedsores and pneumonia.

In approaching such a problem, it is helpful to consider why failures occur. Therefore, we have briefly analyzed the causes as we see them, and have divided them into two groups:

1. Physical incompetence of the patient's body and collapse of the functions necessary to heal the broken bone or to sustain life:
  - a. Local circulatory failure;
  - b. General collapse of the vital functions, due to senility or to constitutional disease.
2. Imperfect fixation of the fracture:
  - a. Imperfect reduction;
  - b. Splitting or comminution of the fragments;
  - c. Faulty placement of the fixation device;
  - d. Selection of a relatively ineffective fixation device;
  - e. Insufficient or too violent and extensive impaction;
  - f. Exhaustion of the patient's vitality by prolonged and shocking operative procedures;
  - g. Too short a period of rest in recumbency.

Group 1 is obviously beyond the surgeon's control. We have, therefore, addressed ourselves to the task of so dealing with the causes of failure in Group 2 that we may gain for our patients the most favorable prognosis.

In doing fixation operations, we utilize two special devices: the Cleary hip table<sup>1</sup>, which facilitates both reduction and operation; and the Morrison lock bolt<sup>2</sup>, which assures effective fixation. Obviously, both the table and the bolt are utilizable independently; the table is adapted to any sort of fixation device, and the bolt may be employed in any femoral-neck fracture, regardless of operative approach. The table has been described elsewhere, so that detailed comment upon its construction or operation is unnecessary. Since it is with the peculiar function and usefulness of the bolt that this paper is directly concerned, a brief discussion of its construction and application is in order.

Anchorage of the locking members of the Morrison bolt (Fig. 1) into the relatively dense cancellous bone of the femoral head brings to bear on fixation of fracture of the femoral neck a new and peculiarly effective mechanical principle. This device is a hollow bolt, one-quarter

of an inch in diameter, with a threaded inner shaft, which, when screwed up, forces out two thick expanding blades, hinged at the tip of the bolt. The blades lock when at right angles to the bolt. The thick back surface of each blade is in the direction of traction. (The tremendous holding

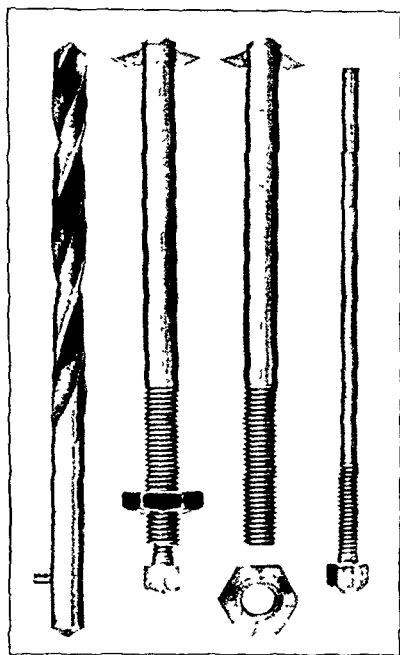


FIG. 1

The Morrison lock bolt.

power of the expanded blades is evidenced by observations discussed later under the technique of impaction.) Unscrewing the inner shaft will release the blades and, when they are thus released, a tug on the bolt causes them to collapse beyond its tip, where they offer no resistance to its removal. It is essential that all parts of the bolt be made of 18-8\* *non-magnetic* (austenitic) stainless steel. Such bolts, removed as long as one year after insertion, have shown no corrosion. We have found that a stainless-steel plate, which lies along the lateral surface of the femoral shaft with its proximal extremity clamped to the lock bolt by the addition of a second nut and its distal extremity fixed to the bone by a suitable screw, gives admirable control of *intertrochanteric* fractures (Figs. 11-A and 11-B) (Case 28). Use of the bolt with this accessory plate permits the same desirable post-

operative freedom in cases of *intertrochanteric* fracture as does bolt fixation in cases of *intracapsular* fracture. Figures 6-A through 11-B show views of fractures which have been reduced and the fragments bolted in typical cases taken from our series.

#### TECHNIQUE

##### *Anaesthesia*

Basal anaesthesia of sixty to seventy milligrams of avertin per kilogram of body weight is supplemented by local infiltration of the joint and of the operative field by novocain. Avertin counteracts any untoward reaction from the novocain. The usual precautions, such as intravenous fluids and respiratory stimulants, are held in readiness, but are seldom needed.

##### *Reduction, Immobilization, and Roentgenographic Localization*

The patient is placed upon the table after avertin and local anaesthesia of the joint. The fractured leg is placed in the leg holder, with both knee and thigh flexed to a right angle. When sufficient traction has been made by turning the traction screw of this leg holder, the leg is

\* 18 per cent. chromium and 8 per cent. nickel.

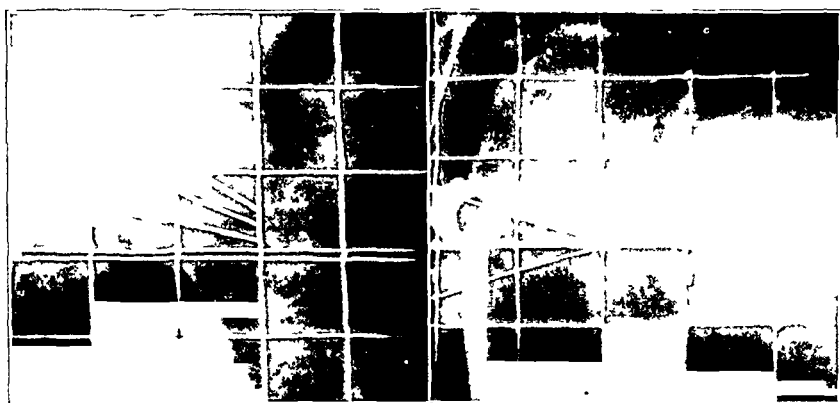


FIG 2-A

FIG 2-B

Case 8

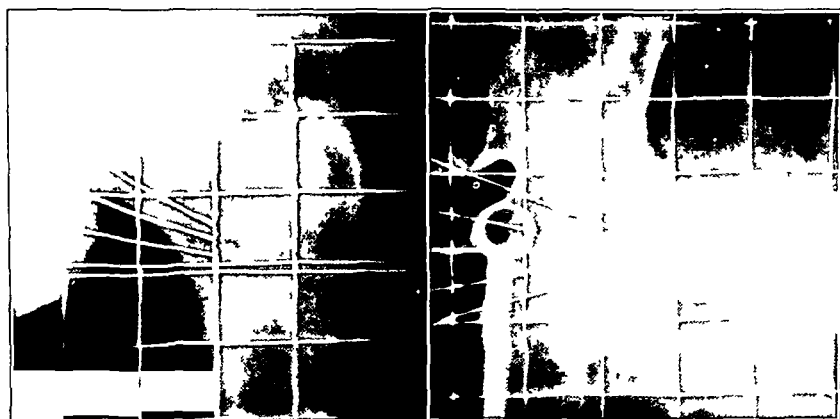


FIG 3-A

FIG 3-B

Case 24



FIG 4-A

FIG. 4-B

Case 26

Anteroposterior and lateral views, after reduction, but before bolting.

put into slight internal rotation, and the holder is locked by a turn of the locking screw. This reduces the fracture and accomplishes any degree of valgus desired. Anteroposterior and lateral roentgenograms (Figs. 2-A through 4-B) are then taken. The immobilized leg remains in position without further attention.

### Operation

An incision is made laterally over and parallel to the upper part of the femoral shaft. The length of the incision is a matter of convenience—approximately four inches in thin patients and slightly longer in fat ones. The lateral subtrochanteric surface of the bone is exposed. The point of entry of the drill is determined by reference to the anteroposterior roentgenogram (Figs. 2-A, 3-A, and 4-A) and is marked on the bone with the aid of the directing device on the table. The angle of the neck axis is determined by consulting both lateral and anteroposterior roentgenograms (Figs. 2-A through 4-B), and the one-fourth-inch drill, set at the angle of the neck axis and guided by the directing device on the table, is entered at the previously marked point on the bone and, by means of a hand brace, is driven through the trochanteric fragment into the femoral head. The drill can usually be felt to traverse the fracture

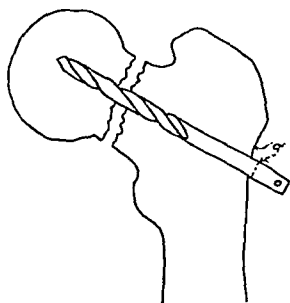


FIG. 5-A

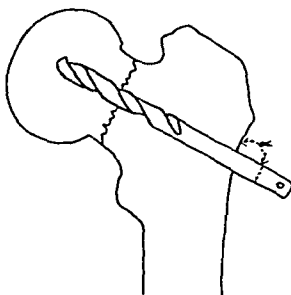


FIG. 5-B

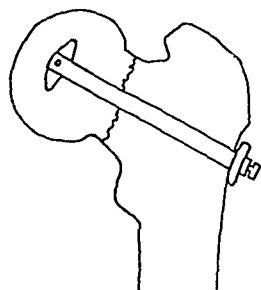


FIG. 5-C

area. Increased resistance accompanies its penetration of the relatively dense cancellous structure of the head fragment (Fig. 5-A).

Impaction, the next step, is very important. Blows from a mallet, transmitted through a suitable mandrel, drive the trochanteric fragment against the head *while the drill is in place*. By this unique method, displacement of the head fragment during impaction is prevented, and the *degree of impaction* is measurable (Fig. 5-A). The amount of increased protrusion of the drill produced by the impacting force is the width of the interfragmental space obliterated (Fig. 5-B). Impaction is adequate when a moderate blow does not increase protrusion of the drill. The drill is then turned in until the mark upon it, three and one-half inches from its cutting tip, is again flush with the bone surface. The expanding blades of the lock bolt are properly set, and the nut is turned out to the opposite extremity of the shaft. The drill is withdrawn, and the bolt is inserted. The expanding blades are forced out by screwing

TABLE I  
ANALYSIS OF THIRTY-TWO CASES TREATED BY THE LOCK-BOLT METHOD OF FIXATION

Case	Sex	Age (Years)	Type and Site of Fracture	General Condition	Date of Injury	Date of Operation	Complications	End Result
1. L. W.	Female	58	Intracapsular, right femoral neck	Good	Feb. 28, 1937	Mar. 1, 1937	None	Complete recovery, with bony union.
2. F. D.	Female	61	Intracapsular, left femoral neck	Good	Sept. 29, 1937	Oct. 4, 1937 Dec. 15, 1937	None	Complete recovery, with bony union.
3. E. S.	Female	68	Intracapsular, right femoral neck	Poor (convalescing from severe pneumonia)	Dec. 17, 1936	Jan. 13, 1937	Arteriosclerosis and hemiplegia	Bony union. Patient died of pneumonia, Sept. 6, 1937.
4. N. N.	Female	52	Impacted intracapsular, right femoral neck	Good	Jan. 17, 1938	Jan. 19, 1938	None	Complete recovery.
5. C. J. P.	Female	63	Intracapsular, left femoral neck	Good	Dec. 8, 1937	Dec. 10, 1937	None	Absorption of neck. Bolt in place, with increased protrusion through trochanter. Probable bony union of head to base of neck.
6. J. F. L.	Female	54	Intracapsular, right femoral neck	Good	Apr. 27, 1938	May 4, 1938	None	Complete recovery.
7. J. O. N.	Female	66	Intracapsular, right femoral neck	Good	July 15, 1938	July 21, 1938	None	Complete recovery.
8. L. K. M.	Male	33	Intracapsular, left femoral neck	Good	Sept. 26, 1938	Oct. 13, 1938	None	Complete recovery.
9. F. B.	Male	42	Intracapsular, left femoral neck	Good	Oct. 25, 1937	Nov. 3, 1937	None	Complete recovery.
10. J. V.	Male	42	Intracapsular, right femoral neck	Good	July 30, 1938	Aug. 1, 1938	Phlebitis	Good recovery, with bony union.
11. P. M.	Male	42	Intertrochanteric, left femur	Good	Aug. 25, 1937	Sept. 22, 1937	None	Bony union, with some coxa vara.
12. A. U.	Female	65	Intracapsular, left femoral neck	Good	Apr. 16, 1938	Apr. 17, 1938	None	Complete recovery, with bony union.
13. A. D.	Female	67	Intracapsular, left femoral neck	Poor	Nov. 14, 1938	Nov. 22, 1938	Phlebitis	Complete recovery.
14. O. W.	Male	56	Intracapsular, right femoral neck	Poor (hypertension, chronic nephritis, cerebral occlusions, right hemiplegia)	Mar. 13, 1936	Mar. 29, 1936	Decubiti and carbuncles	Bony union, but patient unable to walk because of right hemiplegia. Died 1 year later.

TABLE I (Continued)

Case	Sex	Age (Years)	Type and Site of Fracture	General Condition	Date of Injury	Date of Operation	Complications	End Result
15. G. S.	Female	61	Intracapsular, left femoral neck	Poor (albuminuria and senile mental deterioration)	Feb. 15, 1937	Feb. 17, 1937	None	Head slipped into varus position and additional nail inserted below bolt 6 weeks after operation. Patient still using crutches.
16. M. W.	Female	67	Intracapsular, left femoral neck	Very poor	Mar. 12, 1938	Mar. 29, 1938	Decubiti	Died of pneumonia within a month.
17. J. R. H.	Female	67	Comminuted intracapsular, right femoral neck	Poor (pulmonary tuberculosis, atrophic arthritis, carcinoma of the cervix uteri)	Jan. 14, 1938	Feb. 2, 1938	None	Union of fracture. Patient has since died of carcinoma.
18. A. D.	Female	70	Comminuted intertrochanteric, right femur	Very poor (patient not ambulatory for 6 years)	Oct. 25, 1936	Oct. 28, 1936	None	Union, with coxa vara. Patient died 4 months after injury.
19. W. McK.	Male	72	Intracapsular, right femoral neck	Poor (diabetes and senile mental deterioration)	Feb. 5, 1937	Feb. 6, 1937	Increased mental confusion	Union of fracture. Patient ambulatory without support for several weeks, but died of diabetes, June 27, 1937.
20. A. B.	Male	72	Intertrochanteric, left stump from previous amputation, Oct. 28, 1936	Fair	Oct. 28, 1936	Nov. 11, 1936	None	Union, with some distortion. Bolt removed Apr. 12, 1937. Patient died of carcinoma of sigmoid, Nov. 21, 1938.
21. M. E. B.	Female	73	Intracapsular, right femoral neck	Poor (senile, edentulous, cardiac irregularity, albuminuria, and casts)	Feb. 19, 1939	Feb. 22, 1939	None	Recovery. Patient ambulatory without support.
22. C. O'D.	Female	74	Intracapsular, left femoral neck	Poor (senile arteriosclerosis and emphysema)	Oct. 12, 1937	Oct. 13, 1937 Nov. 11, 1937	Influenza	Union progressing satisfactorily at time of death from influenza bronchopneumonia, Jan. 22, 1938.

23. M. T.	Female	79	Intracapsular, left femoral neck	Fair	May 20, 1937	May 23, 1937	None	Absorption of neck after 5 months, but bolt held in head which slipped down next to trochanter. No pain, but considerable shortening. Patient still uses crutches.
24. S. I.	Male	83	Intracapsular, left femoral neck	Poor (convalescing from pneumonia)	Oct. 2, 1938	Oct. 3, 1938 Oct. 25, 1938	None	Progress satisfactory until death from pneumonia, Jan. 14, 1939.
25. H. S.	Female	92	Intracapsular, right femoral neck	Poor (marked arteriosclerosis)	Oct. 1, 1938	Oct. 19, 1938	Hypostatic pneumonia	Patient died of hypostatic pneumonia, Nov. 13, 1938.
26. E. R.	Female	92	Intracapsular, right femoral neck	Good	Oct. 16, 1938	Oct. 17, 1938	None	Convalescence uneventful until pneumonia caused death, Jan. 3, 1939.
27. A. M.	Female	62	Intracapsular, right femoral neck	Very poor	Apr. 29, 1937	May 16, 1937	Hypostatic pneumonia	Patient died 4 days after operation.
28. M. R.	Female	83	Intertrochanteric, left femur	Good	Dec. 16, 1938	Dec. 21, 1938*	None	Union. Patient left hospital, Apr. 1, 1939, walking with cane. Bolt and plate still in place.
29. A. F.	Female	78	Intertrochanteric, left femur	Poor (marked arteriosclerosis)	Mar. 28, 1939	Apr. 1, 1939		Patient died of bronchopneumonia, Apr. 3, 1939.
30. A. B.	Female	74	Comminuted intertrochanteric, right femur	Poor	May 11, 1939	May 17, 1939*		Bolt placed too far down shaft. Patient died of bronchopneumonia, May 23, 1939.
31. M. T.	Female	76	Intracapsular, right femoral neck	Poor (hemiplegia, paralysis agitations, and probable carcinoma of colon)	May 1, 1939	May 19, 1939	None	Excellent reduction and fixation. Immediate postoperative convalescence satisfactory.
32. R. L.	Female	64	Intertrochanteric, left femur	Fair (marked arteriosclerosis)	May 18, 1939	May 24, 1939*	None	Firm union in practically perfect position. Patient walks very little because of extreme general weakness.

\* Morrison bolt reinforced with steel plate and screw.

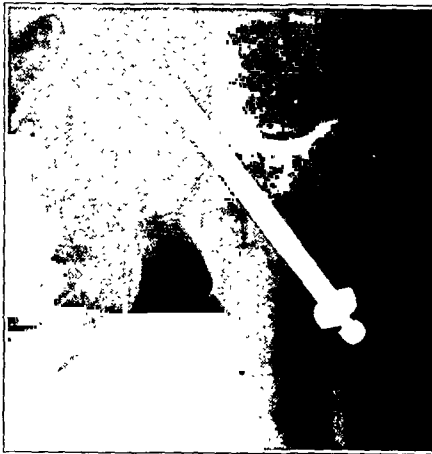


FIG. 6-A

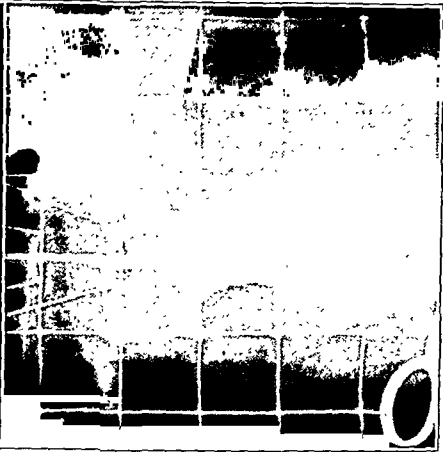


FIG. 6-B

Case 24



FIG. 7-A



FIG. 7-B

Case 3



FIG. 8-A



FIG. 8-B

Case 10

Anteroposterior and lateral views, after lock-bolt fixation.





FIG. 9-A

FIG. 9-B

Case 1



FIG. 10-A

FIG. 10-B

Case 23

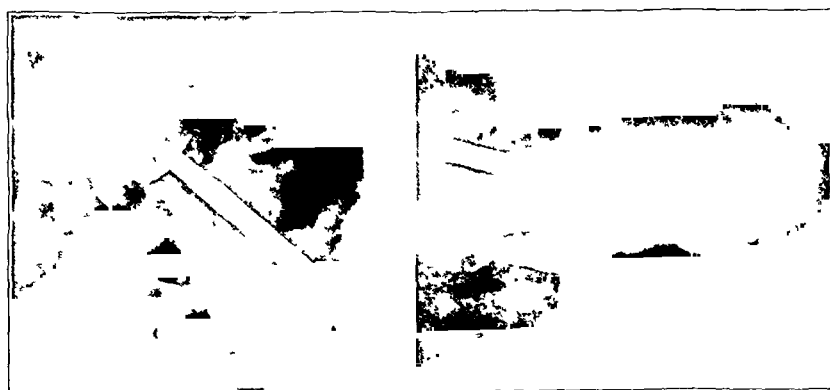


FIG. 11-A

FIG. 11-B

Case 28

Anteroposterior and lateral views, after lock-bolt fixation.



FIG. 12-A

FIG. 12-B

FIG. 12-C

Fig. 12-A: Case 19. Unreduced fracture.

Figs. 12-B and 12-C: Anteroposterior and lateral views, after reduction and bolting.

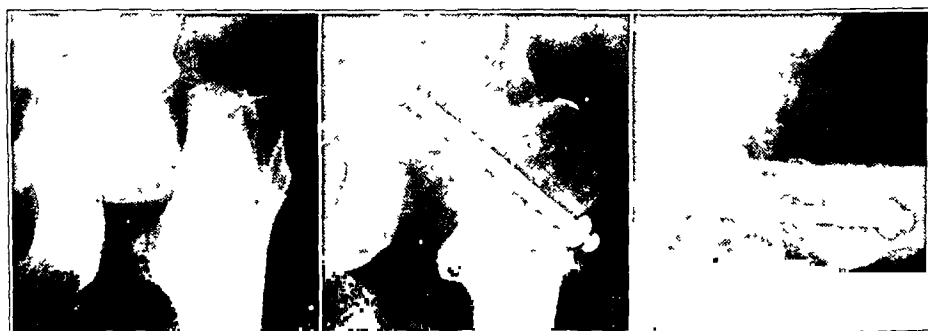


FIG. 13-A

FIG. 13-B

FIG. 13-C

Fig. 13-A: Case 2. Unreduced fracture.

Figs. 13-B and 13-C: Anteroposterior and lateral views, after reduction and bolting.

up the inner shaft (Fig. 5-C). When the blades are fully expanded, the inner shaft cannot be turned any farther. (Note that, since impaction is obtained while the drill is in place, the bolt does not initiate impaction, but maintains and augments it.) Primary impaction by the bolt leads to undesirable protrusion of the exposed bolt shaft, and impaction over the drill eliminates the possibility of angulation of the head fragment during adjustment of the bolt. When the bolt is in place, the wound is closed with ordinary care, a dressing is applied, and the patient is returned to bed. The remarkable holding power of the expanding blades has been demonstrated in two cases, in each of which the operator was unfamiliar with the method of controlled impaction which has been described. In one case, the nut was tightened until the cortex collapsed inward; in the other, the cortex did not collapse, but the fragments were impacted into each other a full centimeter at the fracture line. In both cases, the bolt remained securely locked in the head.

### *Postoperative Care*

From the first day, the patient may sit upright or be freely turned. Active motion is started as soon as the stitches have been removed; al-



FIG. 14-A

FIG. 14-B

FIG. 14-C

Fig. 14-A: Case 7. Unreduced fracture.

Figs. 14-B and 14-C: Anteroposterior and lateral views, after reduction and bolting.



FIG. 15-A

FIG. 15-B

FIG. 15-C

Fig. 15-A: Case 12. Unreduced fracture.

Figs. 15-B and 15-C: Anteroposterior and lateral views, after reduction and bolting.

though we have found our method of fixation so secure as to be almost accident-proof, yet we eschew spectacular demonstrations of early weight-bearing because of the unwarranted increased risk. We believe that at least six weeks' recumbency is consistent with the magnitude of the problem of bone repair in fractures of the femoral neck. Full weight-bearing is not permitted until the fourth month. It may be still further deferred according to individual indications.

#### ANALYSIS OF CASES

This procedure has been used in a series of thirty-two cases. Twenty-four of the patients were women, and eight were men. Only four patients, all males, were under fifty. Of the remaining twenty-eight, four were between fifty and sixty; eleven, between sixty and seventy; nine, between seventy and eighty; two, between eighty and ninety; and two, between ninety and 100.

In twenty-five cases the fractures were intracapsular; in seven, intertrochanteric. Fourteen of the thirty-two patients are now dead. Three deaths occurred within one week after operation; two, within one month; and three, within three months. Bony union was obtained in twenty

cases, of which fifteen were intracapsular fractures. Of the five cases of intertrochanteric fracture, union occurred without significant distortion in two of the three cases in which the bolt was supplemented by a steel plate and screw; in two of the three remaining cases, coxa vara was present.

#### CONCLUSIONS

Extra-articular internal fixation of femoral-neck fractures by means of the devices and method which we have described is so easily accomplished and has been productive of such good results that we believe it is the procedure of choice, regardless of the age and general condition, for any patient who is not already dying. Consequently, we think it unnecessary to submit such patients to the increased hazard of arthrotomy.

Fixation has facilitated general care, promoted comfort, lessened the incidence of complications, and bettered the chance of weathering such complications when they have occurred. It affords the best possibility of ultimate recovery. In the case of those patients for whose recovery there is no reasonable hope, we believe that the greater temporary comfort afforded by fixation makes this active intervention more humanitarian than any less positive plan of treatment.

With resolution born of these convictions, we use the lock-bolt method of fixation in any fracture of the femoral neck, if the patient is not already moribund. While we have had no poor results in patients who were favorable risks, we have been gratified to have obtained good results in some extremely unpromising cases.

From the point of view of recovery or of the accumulation of favorable statistics, the patients who died were obviously impossible surgical risks. In these cases the lock-bolt method was used to promote temporary comfort, to facilitate nursing care, and to render the patients' last days more tolerable. These facts should be kept in mind in making comparisons with other series of cases.

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# SPONTANEOUS SUBCAPITAL HIP FRACTURES OCCURRING IN TABES DORSALIS

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This is a brief summary of a group of cases illustrating a type of hip fracture that apparently is associated with syphilis of the central nervous system. This fracture seems to constitute one of the earliest manifestations of a Charcot joint. The condition is characterized by a spontaneous break through the epiphyseal region between the femoral head and neck, occurring in adults and resembling an adolescent slipped epiphysis. It is usually accompanied by flocculent areas of calcification in the soft tissues around the joint and sometimes by an increased density in the femoral head.

In our experience this fracture has occurred five times in the last four years. A study of all the cases of subcapital hip fracture which have been seen at the Massachusetts General Hospital since 1920 shows that this particular type of fracture may be of significance clinically. The literature contains no specific reference to the occurrence of subcapital hip fractures in tabes, although one case with roentgenographic findings quite similar to ours was found in one of Steindler's articles on neuropathic arthropathy<sup>8</sup>.

It is well known that a spontaneous fracture is frequently the first evidence of a Charcot joint. Many clinicians have stated that such neuropathic joint changes are not uncommonly the first sign of tabes itself.<sup>1, 2, 4, 6, 8</sup> In the past two decades, with the development of refined diagnostic tests and newer methods of antiluetic treatment, various atypical signs of syphilis have been noted. A spontaneous subcapital hip fracture, to our knowledge, is an unusual manifestation of tabes.

CASE 1 (BM-14338). A businessman, forty-five years of age, a patient of Dr. J. B. Ayer's, had been treated for tabes seven years before entry. Six weeks previous to admission, while reaching to adjust a curtain, he suddenly felt a sharp pain in the left buttock radiating down the posterior aspect of the thigh and leg. He had recovered sufficiently to enter a bowling match a week later, when the pain recurred. Thereafter he limped around, but walking became increasingly more difficult.

Physical examination showed the classic signs of tabes. The blood and spinal-fluid Wassermann reactions were negative, and the gold sol curve was 4444321000. Roentgenograms (Fig. 1) showed a clean-cut separation between the femoral head and neck exactly at the epiphyseal line with flocculent areas of calcification in the soft tissues.

A Whitman reconstruction was done. The femoral head was sent to Dr. D. B. Phemister, at the University of Chicago, for examination. He reported that the specimen was made up chiefly of dead bone and showed the degenerative changes seen in Charcot joints. Roentgenograms taken six months after operation (Fig. 2) revealed the prolific masses of calcification that are often associated with Charcot joints. Figure

3 shows the joint sixteen months after fracture, with the process slightly more advanced. There was partial limitation in the movements of the hip at this time, especially as regards abduction and adduction. The patient is now able to walk and no longer complains of pain in the hip.

**CASE 2 (U17993).** A sixty-year-old white male had been followed in the Out-Patient Department since 1919 for taboparesis. In 1929, because of penetrating trophic ulcers, his right leg was amputated below the knee. At that time the blood and spinal-fluid Wassermann reactions were positive. Later, an artificial limb was used. During the next six years he came to the Out-Patient Department for injections of tryparsamide and bismuth salicylate. In October 1935, while walking across the street with the aid of a crutch, he stumbled and sat down forcibly. He felt no pain, but the right lower extremity felt insecure. Three days later he came to the Hospital where roentgenograms (Fig. 4) showed a subcapital fracture of the right femur and flecky areas of calcification in the soft tissues. Because he was a poor operative risk, no surgery was done. The blood and spinal-fluid Wassermann reactions at this time were negative. A roentgenogram taken one year later (Fig. 5) showed marked osteoporosis of the bones of the hip with external rotation of the femur.

**CASE 3 (U36163).** A white male, sixty-four years of age, had been vigorously treated for tabes since 1925. In 1934 the blood Hinton test was positive, the blood and spinal-fluid Wassermann reactions were negative, and the gold sol curve was 0001100000. At this time, because of stabbing pain radiating down both lower extremities, roentgenograms of the pelvis and the lumbar spine were taken (Fig. 6).

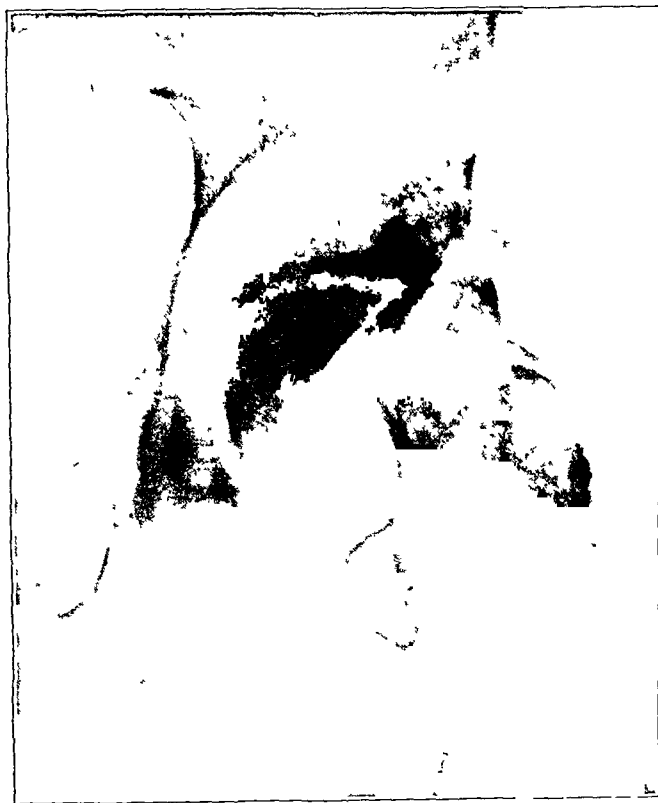


FIG. 1

Case 1. Spontaneous hip fracture in tabes. Note the break through the site of the epiphyseal line and the flocculent areas of calcification in the soft tissues.

A pathological fracture of the first lumbar vertebra was found, but the pelvis, aside from a few hypertrophic changes, was normal. Three years later, while disentangling himself from some bed-clothes, he suddenly felt a sharp pain in the left hip. On admission, several weeks later, roentgenograms (Fig. 7) showed no change in the appearance of the spine, but there was a fracture of the left femoral neck through the exact position of the epiphyseal line, simulating a slipped epiphysis in an adolescent. Flecks of calcium were seen surrounding the fracture, and the head of the femur appeared denser than the surrounding bones. There was some absorption of the neck, suggesting that changes had taken place since the fracture. At operation, a fungating mass of granulation tissue was found surrounding the neck



FIG. 3

Case 1. The same patient sixteen months after fracture, showing extensive new-bone formation.



FIG. 2

Case 1. The same hip six months after Whitman reconstruction. Note the unusual pericapsular calcification.



FIG. 4

Case 2. An old tabetic with a subcapital hip fracture showing fleecy areas of calcification in the soft tissues.

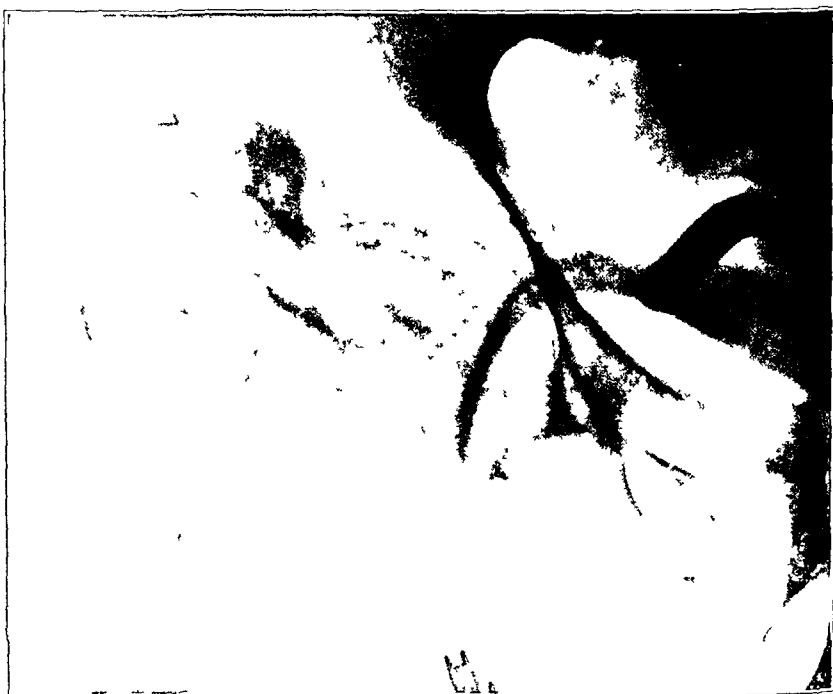


FIG 5

Case 2. One year after the fracture had occurred there was marked osteoporosis of the bones of the hip with the femur externally rotated.





FIG. 7

Case 3. In 1937 a spontaneous fracture developed in the left femoral neck through the subcapital region with flecky areas of calcification in the soft tissues



FIG. 6

Case 3. A tabetic whose left hip in 1934 showed only hypertrophic changes

This patient was a sixty-year-old male (U163561), who received postoperative radiation following amputation of the penis for adenocarcinoma. Sixteen hundred roentgen units were given to each groin through a ten-by-fifteen field, using 200 kilovolts, at a skin-target distance of fifty centimeters, filtered through five-tenths of a millimeter of copper and one millimeter of aluminum, in daily doses of 300 roentgen units. Four months after the course of radiation had been completed, the patient first complained of pain in the left leg. Roentgenograms at that time (Fig. 10) showed a subcapital fracture of the left hip. Eight months later, the fracture was quite obvious (Fig. 11), but the heads of both femora remained dense despite the atrophy of the other bones surrounding the joint. There was no evidence of metastasis anywhere in the body. The patient gave no history of lues, and the blood and spinal-fluid Wassermann reactions were negative.

We assumed that this man's bone pathology was secondary to an obliterative endarteritis due to radiation, a condition of which there are twenty-two other cases reported in the literature.

Old untreated traumatic fractures of the femoral neck with bone absorption in the proximal part of the neck may occasionally simulate the roentgenographic appearance of a true subcapital fracture. However, the absence of calcification in the soft tissues and the presence of marked bone atrophy, together with a history of trauma, pain in the joint, and the absence of tabes dorsalis clinically differentiate an old traumatic hip fracture from a spontaneous tabetic hip fracture.

#### DISCUSSION

Little is known of the pathogenesis of spontaneous subcapital hip fractures in tabes aside from the usual theories on the origin of Charcot joints. One may only speculate in the light of our present knowledge as to why the epiphyseal region between the femoral head and neck should be a weak point through which a Charcot fracture first occurs. There seems to be no evidence to indicate a relationship between this condition and epiphyseal syphilis or slipped epiphyses in children. The fact that this region of the femoral neck anatomically has not as rich a blood supply as the rest of the femur suggests a trophic (nutritive) factor.

However, the so-called trophic disturbance as an etiological factor in neuropathic joints has fallen into disrepute because vascular lesions are so rarely demonstrated pathologically in Charcot joints.<sup>8</sup> On the other hand, in radiation osteitis there are definite changes in the blood vessels supplying the bone.<sup>5</sup> In the cases of radiation osteonecrosis of the hip joint reported by Dalby, Jacox, and Miller, the initial changes usually developed in the superior portion of the femoral head close to the neck.<sup>7</sup> Such fractures apparently differ from the spontaneous subcapital hip fractures of tabes in that the process is chiefly osteolytic, whereas a tabetic fracture usually shows extracapsular areas of calcification in the soft tissues. The latter changes may be attributed to the well-known impaired afferent nerve function of a neuropathic joint. A joint thus deprived of its most important protective mechanism is subjected abnormally to stress, strain, and trauma. These produce stretching of the joint capsule, marginal erosions, and chip fractures, thereby liberating in the soft tissues osteo-



FIG. 11

Radiation osteonecrosis. The same hip as in Fig. 10 eight months later, with an obvious fracture.



FIG. 10

Spontaneous subcapital fracture of the left hip following roentgen-ray irradiation to the pelvis.

phytes and blood, which account for the shadows of the calcified masses seen in the roentgenogram.

It is recalled that some authorities recognize two types of Charcot joints—the atrophic and the hypertrophic—according to the relative presence or absence of new-bone formation around the joint. Variations and gradations of these types occur. The cases just presented illustrate that spontaneous hip fractures occurring in tabes may resemble one another at first, but later varying amounts of new bone frequently develop in the vicinity of the joint, supposedly depending upon the amount of trauma to which the neuropathic joint has been subjected.

#### SUMMARY AND CONCLUSIONS

1. A study of all the cases of hip fracture seen at the Massachusetts General Hospital since 1920 revealed five cases of spontaneous fracture of the neck of the femur through the site of the epiphyseal line in adults. Three of these patients were known tabetics. Recognition of the fracture in another case led to a diagnosis of latent syphilis. A similar fracture was seen in only one other condition,—namely, radiation osteonecrosis.

2. The condition is recognized by four diagnostic criteria: (1) a break through the epiphyseal region between the femoral head and neck; (2) flocculent areas of calcification in the soft tissues surrounding the hip joint; (3) an apparent increased density of the femoral head; and (4) a history of little or no trauma to account for the fracture.

3. In view of the pathology and clinical aspects of these cases, one is justified in suspecting tabes when this fracture occurs.

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# CONGENITAL SUBLUXATION OF THE FIFTH TOE AND ITS CORRECTION BY A PERIOSTEOCAPSULOPLASTY AND TENDON TRANSPLANTATION

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The condition herewith described is a congenital varus deformity of the fifth toe, in which there is a dorsal subluxation of the fifth metatarsophalangeal joint, with adduction of the entire little toe, so that it overlies the fourth toe and is externally rotated (Figs. 1-A and 2-A). Its appearance is typical, and, like the hallux valgus and the varus minimi digiti, it belongs to the group of toe deformities which occur at a sagittal plane. This condition, however, is to be differentiated from these other deformities by the fact that there is a dorsal subluxation of the fifth metatarsophalangeal



FIG. 1-A

Case 207712. Typical appearance of congenital subluxation of the fifth toe.



FIG. 1-B

Three months after operation. Good result. Note that the fifth toe is straight, but one-eighth of an inch off the floor.

joint. Passive correction of the deformity is readily accomplished, and palpation discloses that the tendon of the extensor digitorum longus of the fifth toe is displaced medially and shortened, while the skin, the fascia, and the capsule at its mediodorsal surface are contracted. Release of the corrective forces causes the deformity to recur.

The condition exists at birth, and several cases which it has been possible to trace seem to prove its hereditary character. As to its pathogenesis, a prolonged malposition of the fifth toe during intra-uterine life appears to the author more likely to be the cause than failure of proper development of the articular surfaces of the fifth metatarsophalangeal joint. The deformity may be unilateral or bilateral, and it is equally distributed between the sexes.

The condition is not rare, and often surgical advice is sought either for the cosmetic appearance or for the relief of disturbances which occur from the friction of the footwear on the misplaced little toe. During the last five years, sixty cases were seen at the New York Orthopaedic Dispensary and Hospital.

The scanty literature on this condition may be explained by the



FIG. 2-A

Case 156671. Before operation.

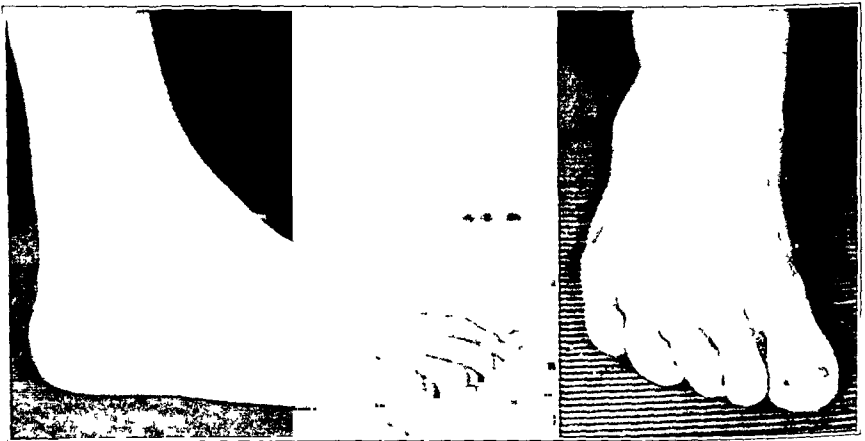


FIG. 2-B

Seven months after operation. Excellent result.

unsatisfactory results obtained from the various conservative and plastic procedures. At the New York Orthopaedic Dispensary and Hospital the recognized treatment for the condition is amputation of the little toe. Such treatment cures the condition, but it entails the loss of the toe. Its surgical technique is simple and does not merit reporting. At various times attempts have been made by some members of the Staff to correct the deformity by such methods as prolonged splinting, tenotomy of the shortened tendon with or without release of the contracted capsule, etc., but these attempts have met with failure and so have been abandoned and have not been reported. It is assumed that other orthopaedic surgeons have had similar experiences.



FIG. 3

Case 117165. Five years after operation. Excellent result.

While amputation of the toe causes no functional disturbances, affords relief of pain, and improves the cosmetic appearance of the foot, the majority of our patients will not avail themselves of such treatment, either because they do not like the idea of parting with a healthy but deformed member of their body, or because of superstition. To this group of patients may be added a few young men who are about to apply for Civil Service, in which the existence of this condition or its correction by amputation implies rejection,—at least such is the case in New York State. The desire to help such a young man, whose application for Civil-Service employment would have met with rejection on account of the deformity of the fifth toe, led us to devise the following operation.

#### OPERATIVE PROCEDURE

A two-inch longitudinal incision is made through the skin and subcutaneous tissue over the dorsal surface of the fifth metatarsophalangeal joint, and is centered at the joint. The extensor digitorum longus tendon of the fifth toe is isolated and divided at the distal end of the incision. The periosteum of the distal end of the fifth metatarsal, the capsule, and the periosteum of the proximal phalanx are next incised longitudinally

and are then elevated subperiosteally from the dorsal, lateral, and medial surfaces, leaving their plantar attachments undisturbed. With a drill, a tunnel is made at the distal end of the fifth metatarsal, and the proximal end of the previously severed tendon of the extensor digitorum longus is threaded through and sutured back onto itself with two forty-day chromic sutures. A mattress suture is placed in the periosteocapsular flap; starting laterally, and proximal to the metatarsal head, the needle passes under the metatarsal neck to the medial flap proximally, next to the medial flap distally, and then under the phalangeal neck and through the lateral flap distally. The toe is plantar-flexed, and the mattress suture is tied. As a result of the tension exerted by the periosteocapsular flap, the toe is now stable, occupying a normal position without support. The exposed

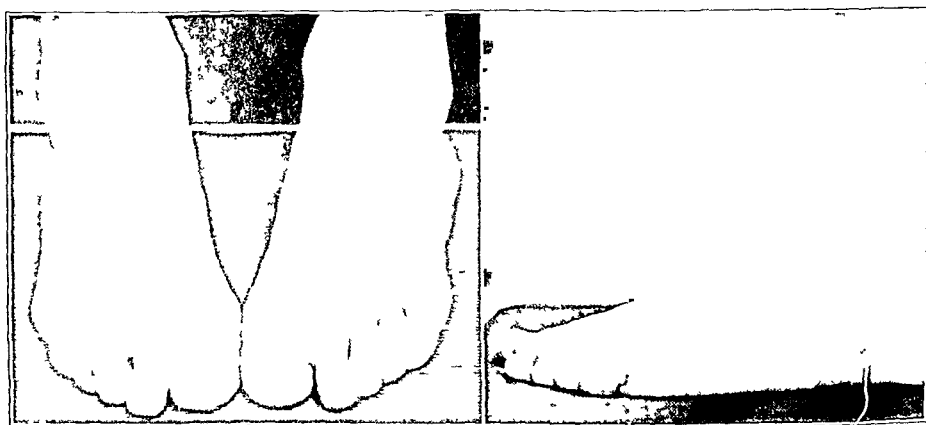


FIG. 4

Case 214840. Four months after operation. Excellent result.

metatarsal, the articulation, and the phalanx are now covered by closing the subcutaneous tissue with plain catgut and the skin with silk sutures. A tourniquet has been used in all cases. The postoperative care consists in maintaining the corrected position by adhesive strapping for about three weeks.

#### END RESULTS

This operation was first attempted on February 27, 1933, with success. Since then, nineteen patients have been operated upon; in six cases the deformity was bilateral, so that, in all, twenty-five operations have been performed (Figs. 1-B, 2-B, 3, and 4). The ages ranged from two to twenty-five years, the average age being twelve years.

The postoperative follow-up periods in this series ranged from eight months to six years. Excellent results were obtained in sixteen operations; good results, in four; and poor results in three. One patient with bilateral deformity has not been seen since operation. In the group with poor results is included a patient whose age at the time of operation was two years, which has proved too early for obtaining a good periosteocapsular flap.



# THYROID TUMOR OF THE HUMERUS WITHOUT DEMONSTRABLE GOITER

## REPORT OF A CASE WITH BIOLOGICAL ASSAY OF THE TUMOR

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So-called benign metastasizing goiter has been known since Cohnheim described the first case in 1876. In 1926 Simpson thoroughly reviewed seventy-seven reported cases and added three of his own. In this study he mentioned two cases recorded by Zapelloni, wherein there were no signs of goiter or of thyroid cancer. In 1927 Prof. Alessandri of Rome mentioned several similar cases reported in the literature and added two of his own, in which no primary lesion was discovered in the thyroid gland. One of his cases was of particular interest to the authors, since in many details the findings were similar to those in their own case. Alessandri's patient was a laborer, fifty-one years old, who fell on his right shoulder, sustaining a trauma that resulted in a certain amount of limitation of motion. Three years later, he again fell on the same shoulder, and an enlargement of the bone followed. Physical and roentgenographic examinations revealed an expansile tumor of the head of the humerus. The upper end of the humerus was resected. The tumor recurred twenty-one months later, and, over a period of about five years, gradually involved the whole posterior part of the arm and axilla. An intracapsular-thoracic disarticulation was performed. One year after this last operation, or eight years after the first resection, there had been no recurrence. The gross and histological examinations revealed that the growth was a colloid adenoma of the thyroid gland. No detectable changes were found in the thyroid gland, nor were other structures present which might be suspected of being normal or enlarged accessory thyroid glands.

Three explanations of the pathogenesis of such rare growths have been advanced:

1. They may proceed from misplaced embryonal cells; this theory has also been brought forward to account for rare adamantinomata of the long pipe bones.

2. Normal thyroid tissue may break into the blood stream and be carried to bone and there set up a new growth. Such a series of events in fishes has been described by Gaylord; Riedel and Oderfeld and Steinhilber have observed this in thyroid tissue; and Pick and Manasse have noted it in suprarenal tissue.

3. The authors feel that the most logical explanation is the presence

of a miniature malignant adenoma of the thyroid gland, which is not palpable clinically, yet it serves as a primary source of the metastatic growth. Similar tiny primary tumors in the prostate may become widely disseminated. Hypernephromata of minute size may serve as the primary source of distant metastases, and a choriocarcinoma of the testes may be so small that repeated sections are required before the source of a bulky retroperitoneal growth is accounted for. Very small primary lesions in the oropharynx, nasopharynx, or hypopharynx are not infrequently the primary sources of huge growths in the cervical lymph nodes. Hence, in accounting for these thyroid tumors in bone, it seems a rather far cry to rely on such rarely observed phenomena as those mentioned in the first two theories.

#### CASE REPORT

Mrs. S., aged fifty-four, was first seen on July 11, 1935, with a history of aching pain

in the left shoulder of four months' duration. Two weeks after the onset, she had fallen and, although the shoulder was not directly injured, the pain had become intense. She had been much worse since the fall, so that she was unable to move her arm and could not sleep at night. On physical examination, there was marked atrophy of the left shoulder; it was extremely sensitive, and the arm could not be moved without intense pain. There was a palpable tumor mass on the anterior aspect of the head of the humerus. The thyroid gland was not palpable. Laboratory examinations of the blood and urine revealed nothing significant. Wassermann and Kline tests were negative. Roentgenographic examination showed a very destructive process, involving the upper end of the left humerus and extending down the shaft (Fig. 1). Roentgenograms of the lumbar spine, pelvis, femora, and thoracic cage showed no evidence of tumor. A



FIG. 1

Roentgenogram of upper end of humerus, showing central expansile tumor with fracture.

biopsy was done, and "thyroid adenoma of the left humerus" was the diagnosis returned on frozen section. After careful study of the paraffin preparations, the diagnosis of thyroid adenoma was confirmed, but, because of the fact that several competent surgeons were unable to find the slightest evidence of enlargement or nodulation of the thyroid, other possible sources of such a growth were sought. A uterine curettage was done, and the results were negative. Careful urological, gastro-intestinal, and thoracic studies were likewise made in search of a possible primary tumor, and all were negative.

### Operation

Under general anaesthesia, a Larrey incision was made around the left shoulder with a long posterior flap and a short anterior flap. The section was carried down to the joint. The tendons were divided down to the axillary vessels and nerves. These were all caught in hemostats, and the nerves were injected with alcohol and cut off. The arteries were doubly ligated and cut. Due to the extreme vascularity surrounding the tumor, considerable blood was lost during the operation. A good hemostasis was then secured by means of ligatures. The incision was closed in layers with drainage, and a heavy pressure dressing was applied. Shortly after the patient was returned to her room, the blood pressure was 78/50, the pulse was 130, and it was thought advisable to give her a transfusion. This was done, a professional donor being used. Following this, the pulse was 90 and the blood pressure rose. Her condition seemed satisfactory.

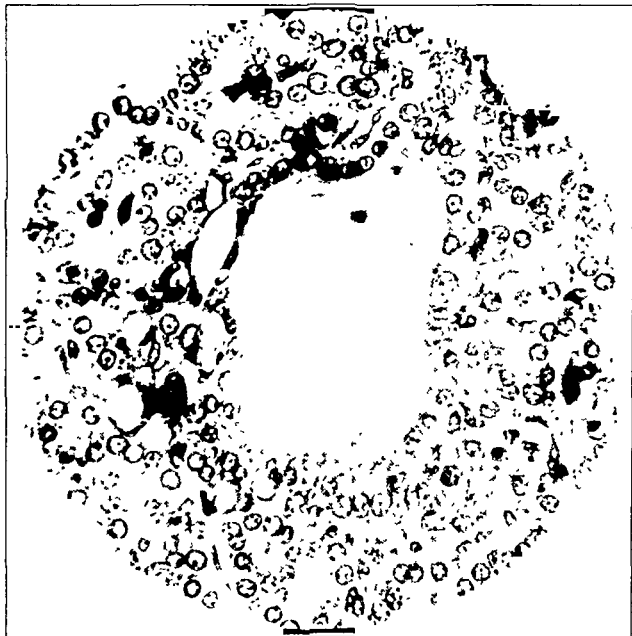


FIG. 2

High-power photomicrograph, showing colloid-bearing thyroid tissue, which is relatively well differentiated.

**Gross Pathology:** The specimen was a left arm, which had been disarticulated at the shoulder joint. It was essentially negative except for the upper one-half of the humerus. The head of the humerus was the seat of a tumor mass practically surrounded by a thin bony capsule, and the area involved by the tumor measured roughly eight by seven by nine centimeters. The bony capsule had been perforated in several places, and there was an area of hemorrhage in the zone where the biopsy specimen was taken. The tumor had broken through the bone shell all along the anterior inferior border of the head of the humerus. On section, a soft, brownish-red, friable, almost jelly-like growth was seen, which extended about two centimeters into the marrow of the shaft of the humerus. The tumor tissue had a smooth, shiny, cut surface and grossly strongly resembled colloid-bearing thyroid tissue. Some areas of hemorrhage and semicystic degeneration were seen on the cut surface.

**Histological Pathology:** The sections showed epithelium-lined acini, which were often seen to be lying upon delicate endothelium-lined vascular channels. Many of the acini contained a pink-staining colloid, and many were empty or the colloid was pale or almost

colorless. Often the colloid was semigranular, and sometimes it showed vacuolization about the border. Many of the small acini were completely closed, due to enlargement or swelling of the lining cells, and in some acini proliferation of the epithelium was seen. The nuclei of the lining acinic epithelial cells showed very little variation in size, shape, or staining. In some areas large endothelium-lined spaces were observed; these were empty except for a scanty amount of material which showed faint reticular markings. These spaces suggested dilated lymphatics. There was little in the histological picture (Fig. 2) to suggest malignancy.

*Biological Assay:* Three groups of five tadpoles each were used. One group was fed on fish food and liver extract; another, on fish food and thyroid extract; and a third, on

a desiccated extract of the tumor, plus fish food. The first group showed no changes after one week. The second group died at the end of a week, all having greatly decreased in size. The third group, which had received the tumor extract, showed prompt decrease in size and two of the group underwent metamorphosis within seven days. Dr. R. M. Isenberger, of the Department of Pharmacology at the University of Kansas, fed extracts of tumor to mice by stomach tube and then poisoned the mice with acetonitrile. He observed a definite protective influence of the tumor extract against the toxic action of this drug as compared with a group of control animals.

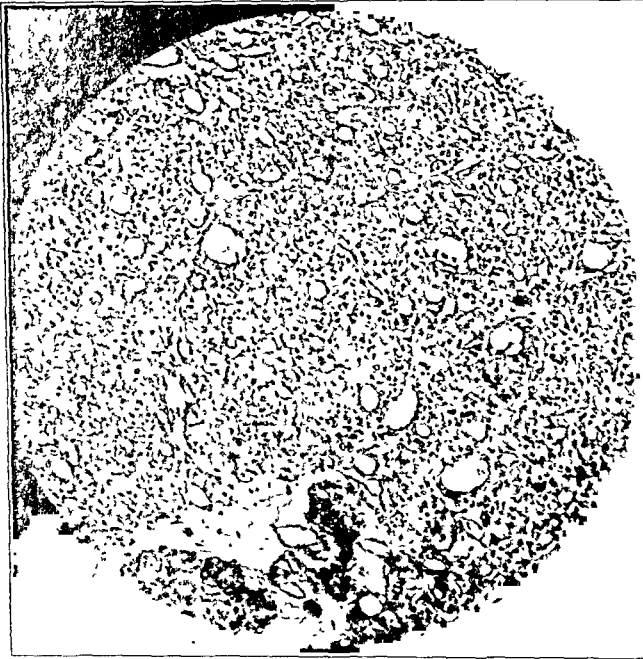


FIG. 3

Low-power photomicrograph of recurrent tumor of the shoulder removed at necropsy.

#### *Progress*

When last seen, on September 17, 1935, the patient was strongly urged to come back for exploration of the thyroid gland. Several letters written to her failed to get any response. In December 1938, approximately three and one-half years after operation, her family physician, Dr. J. J. Hovorka, reported that he had seen the patient some six months previously and that she was complaining of pain in the shoulder stump. On examination he had found a round, well-outlined, pulsating mass at the site of the disarticulation. The patient was extremely nervous, her skin was hot, and her heart pounded continuously. The picture was that of a marked thyrotoxicosis. Roentgenograms of the chest revealed a generalized distribution of mottled opaque areas throughout both lungs, which were diagnosed by the roentgenologist, Dr. E. H. Skinner, as being due to a pronounced bronchial infection. He gave the patient an intensive course of external irradiation over a period of sixteen days, but the shoulder tumor showed no evidence of regression. The roentgenograms of the shoulder revealed an opaque mass eroding the scapula. The basal metabolic rate was plus 31, the pulse was 130, and the blood pressure was 170/90. The blood and urine showed nothing significant. The thyroid was small and slightly nodular. The patient was treated for thyrotoxicosis with Lugol's solution,

sedatives, etc., without effect. She grew progressively more toxic and died in a state of classic thyrotoxicosis. Unfortunately, the only necropsy permission that could be obtained was to remove a small piece of the shoulder tumor. The growth on the shoulder was found to be cystic and densely adherent to and eroding the scapula. The cyst-like spaces in the growth were filled with clear fluid. The thyroid was very small, slightly nodular, and freely movable.

*Gross Pathology:* The material sent to the authors measured fifty by forty by forty millimeters. It was roughly ovoid in shape. The tumor was relatively elastic in consistency, and the cut sections ranged in color from yellowish to grayish-red. There was some adherent bone and fat.

*Histological Pathology:* Sections of the recurrent tumor showed a much more undifferentiated type of growth than had been encountered in the original tumor at operation. The acini were smaller; few contained colloid, and, when colloid was present, it was pale and vacuolated. Many acini were closed by swollen epithelial cells. Often the acini were in solid masses, and these acinic cells showed more nuclear variation than was present in the original tumor. There were also changes in nuclear size and shape in all fields, as well as some hypochromatic and hyperchromatic forms. The same dilated endothelium-lined structures were found as in the original growth, but these contained considerable stringy, pale, pink, granular debris. Patchy zones of oedematous connective tissue were found, which contained isolated, irregular, dilated acini (Fig. 3).

*Diagnosis:* Malignant thyroid adenoma.

#### SUMMARY

A rare instance of so-called primary thyroid tumor of the head of the humerus is reported. On gross and histological examination, the growth resembled a benign adenoma of the thyroid gland. Biological assay with extracts of the tumor showed that it contained a substance which would cause metamorphosis in tadpoles and, when fed to mice, would decrease the toxicity of acetonitrile for these animals; these findings strongly suggested that the tumor contained thyroid hormone.

Amputation failed to effect a cure, and, three and one-half years after disarticulation of the arm at the shoulder, a massive growth recurred. Signs and symptoms of a very acute thyrotoxicosis developed, from which the patient died. Histological examination of the tumor at this time showed it to be much more undifferentiated than the original growth. At no time throughout the entire period of observation until shortly before the patient's death was there any evidence of a growth in the thyroid. At this late date, a very slight lobulation of the gland was palpable, although it was not enlarged and was freely movable.

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# THE PREVENTION OF DEFORMITY OF THE SPINE BY VERTEBRAL FUSION

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Fusion of the spine is used extensively in the treatment of tuberculosis of the vertebrae and of scoliosis. In tuberculosis of the vertebrae it prevents intervertebral motion and thus allows healing to progress more rapidly, while in scoliosis it is used to hold the spine in a position of correction.

If fusion can maintain the spine in a fixed position, one would expect it to prevent deformity. We have very little data relative to this protective influence either from the clinical or from the experimental side.

From experimental investigation we know that vertebral length growth in dogs takes place in the epiphyseal cartilaginous plate at either end of the body of the vertebra.<sup>1</sup> If the epiphyseal cartilaginous plate is injured, growth will be hindered; and, if the injury is asymmetrical, there will be a deformity of the spine.<sup>2</sup> Thus, if a fusion of the spine is performed at the time of deforming injury to the epiphyseal plate, it will be possible to study its protective influence over the deforming factors. Utilizing this idea, the author has performed two series of experiments which will be briefly described. In one series a deformity was produced by boring into the epiphysis and body or by partial destruction of the epiphyseal cartilaginous plate or body, without a fusion; in the other, a similar procedure in conjunction with a fusion of the spine was performed.

## BORING INTO EPIPHYSIS AND BODY

EXPERIMENT 1. Dog 2. December 5, 1937.

*Method:* The bodies of the lumbar vertebrae were exposed through an abdominal approach. With an awl, holes were bored into the body and into the epiphysis, and small wires were placed in the holes.

*Result:* Five months later, sufficient growth disturbance had been produced to cause a moderate kyphosis of the spine (Fig. 1-A).

## BORING INTO EPIPHYSIS AND BODY COMBINED WITH SPINE FUSION

EXPERIMENT 2. Dog 7. March 3, 1938.

*Method:* A fusion of the articular facets was performed. Three weeks later, through an abdominal approach, the bodies of the lumbar vertebrae were exposed. Small holes were bored into the bodies and epiphyses of two vertebrae, and wires were inserted.

*Result:* Five months later, there was no kyphosis of the spine; in fact, there was a definite lordosis of the bodies.

EXPERIMENT 3. Dog 8. March 3, 1938.

*Method:* A fusion of the spine was performed. Three weeks later, through an abdominal approach, the bodies of the lumbar vertebrae were exposed. Small holes were bored into the bodies and epiphyses, and fine wires were inserted.



FIG. 1-A

FIG. 1-B

Fig. 1-A: Experiment 1, Dog 2. The bodies and the epiphyses were injured through an abdominal approach. Notice the kyphosis following collapse and growth disturbance.

Fig. 1-B: Experiment 3, Dog 8. In addition to the body injury, a spine fusion was performed. The fusion has prevented the kyphotic deformity; in fact, there is a moderate lordosis.

plate of one vertebra was identified and directly injured anteriorly by driving an osteotome into it. Holes were bored into the epiphyses and bodies of other vertebrae, and wires were inserted.

*Result:* Five months later, there was a marked kyphotic deformity of the spine with slight scoliosis.

EXPERIMENT 6. Dog 6. November 22, 1937.

*Method:* An experiment similar to Experiment 5 was performed.

*Result:* Five months later, there was no collapse of the vertebrae or tendency to kyphosis, but a definite anterior bowing of the bodies to form a lordosis was noted (Fig. 1-B).

EXPERIMENT 4. Dog 9. March 7, 1938.

*Method:* The same procedure was followed as in Experiments 2 and 3 except that the bodies were injured first and then the spinous processes were fused.

*Result:* Five months later, the form of the vertebrae was changed, but, in spite of this, no kyphosis had taken place.

After simple boring into the epiphyses and the bodies, deformity was prevented by the fusion of the spinous processes. There was a tendency for lordosis after fusion, because the growing bodies were hindered from expanding longitudinally. Since the place of lesser resistance was in the anterior portion of the bodies, a compensatory protrusion or lordosis took place.

#### PARTIAL DESTRUCTION OF EPIPHYSEAL CARTILAGINOUS PLATE

EXPERIMENT 5. Dog 3. November 12, 1937.

*Method:* The bodies of the lumbar vertebrae were exposed through an abdominal incision. The epiphyseal cartilaginous



*Result:* There was a moderate kyphosis with slight scoliosis.

EXPERIMENT 7. Dog 4. November 19, 1937.

*Method:* After the lumbar vertebrae had been exposed, the epiphyseal cartilaginous plates were injured on one side by driving an osteotome into them. Holes were bored and wires were inserted into the epiphyses and bodies of several vertebrae.

*Result:* Six months later, there was a marked scoliosis with a slight kyphosis (Fig. 2-A).

EXPERIMENT 8. Dog 5. November 22, 1937.

*Method:* The operation was similar to that employed in Experiment 7.

*Result:* There was a marked scoliosis with slight kyphosis.

In this series, in which no fusion was performed, a marked deformity resulted in each experiment.

#### PARTIAL DESTRUCTION OF EPIPHYSEAL CARTILAGINOUS PLATE COMBINED WITH SPINE FUSION

EXPERIMENT 9. Dog 10. March 10, 1938.

*Method:* The bodies of the lumbar vertebrae were exposed through the usual abdominal approach. Several of the epiphyseal cartilaginous plates were injured by the insertion of an osteotome. A large hole was bored into the body of one other vertebra, and wires were inserted. Fifteen days after the first operation, the spinous processes were fused.

*Result:* Three months later, there was a very slight tendency to kyphosis at the junction of the lower end of the fused vertebrae (Fig. 2-B). There was a marked destruction of the bodies of the vertebrae, showing that the fusion had prevented the progression of the deformity.

EXPERIMENT 10. Dog 11. March 11, 1938.

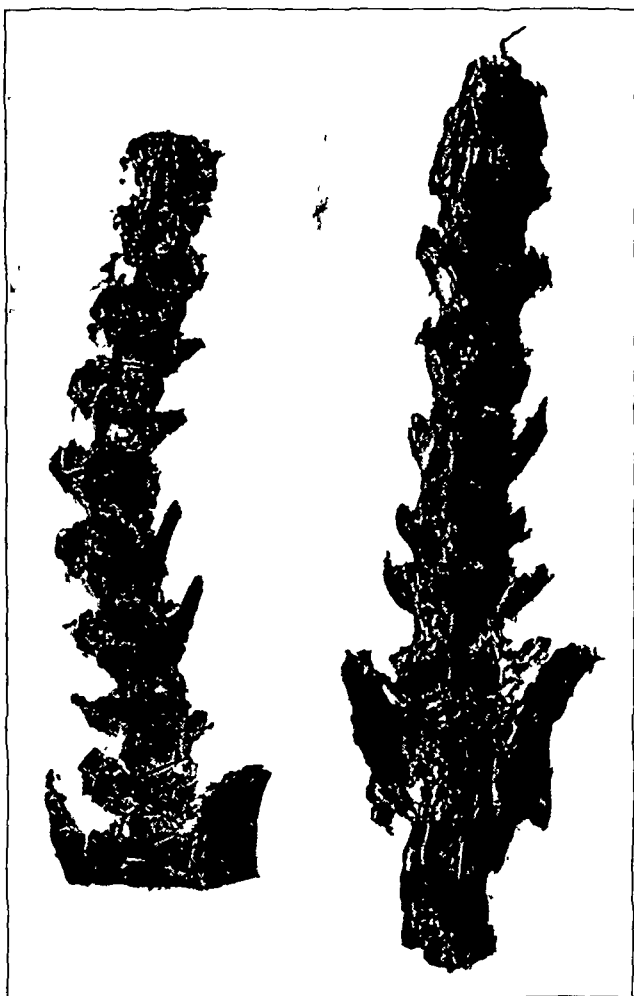


FIG. 2-A

FIG. 2-B

Fig. 2-A: Experiment 7, Dog 4. After exposure of the bodies of the lumbar vertebrae through an abdominal incision, the epiphyseal cartilaginous plates were injured on one side by the driving in of an osteotome. A scoliosis was produced in this experiment.

Fig. 2-B: Experiment 9, Dog 10. The same injury as in Experiment 7 was produced in the epiphyseal cartilaginous plates. In addition, fifteen days later, a spine fusion was performed. This prevented progression of the deformity.

*Method:* Through an abdominal approach, the lumbar vertebrae were exposed. Sections of bone were then thrown up from two adjoining vertebrae and made to contact over the intervertebral disc. This necessitated injuring the epiphyseal cartilaginous plates to about one-third of their depth. Small holes were bored into several other vertebrae, and wires were inserted. Two weeks after the first operation, the spinous processes were fused.

*Result:* Three months later, there was no deformity of the spine, in spite of a considerable injury to the epiphyseal cartilaginous plates. Twelve months later, a fusion took place on the anterior surface of the bodies of the vertebrae. There was no deformity of the spine.

In this series, in which a fusion was performed in conjunction with the injury, no deformity occurred.

#### SUMMARY

Vertebral fusion has a definite preventive influence over deformity of the spine following injury to the epiphyseal plate or vertebral body.

There is a definite tendency toward lordosis after fusion of the spine in growing animals. This is due to the fact that there is some inhibition in longitudinal expansion with compensatory growth anteriorly toward the place of least resistance.

The lordosis may exert a corrective influence over an existing kyphosis. In tuberculosis of the spine there may be a lessening of the deformity after the fusion operation.

This corrective influence should be borne in mind in the treatment of vertebral epiphysitis (kyphosis dorsalis juvenilis).

The preventive influence of fusion over scoliosis is also possibly of clinical value. In paralytic scoliosis the problem is quite complex, because of the multiplicity of forces and the difficulty in knowing the exact site and amount of fusion.

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## TREATMENT OF IMPACTED FRACTURE OF THE NECK OF THE FEMUR

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The more common methods of treating impacted fracture of the neck of the femur include rest in bed, casts, etc., for an extended period of time, the prevention of disimpaction, or the breaking up of the impaction and treatment of the injury as if there were separation of the fragments. A few cases in which locomotion was indulged in from the time of the injury have been reported as rarities. In the case described by Lilienthal, an excellent result, with some shortening, was obtained. In 1924, Speed reported the cases of two patients who walked immediately after the injury. His first patient, a woman of sixty-four years, walked seventeen days before she was seen by him. She was put to bed for a week and then given a walking caliper for eight weeks. His second patient was given a walking caliper after only one day of walking. Speed regards these results as being due to the accidentally fortunate type of impaction. He says: "Should the impaction be of insufficient depth or at an angle less than the normal angle of the femoral neck, we may expect that the impaction will be broken up by attempted use or manipulations and the usual displacement of fragments will result."

Some authors do not believe that true impaction of the fragments occurs. MacAusland, MacAusland, and Lee state: "The fracture designated as impacted is either one of the incomplete variety, or a complete fracture in which, because of the good preservation of the capsule and periosteum, only slight deformity is present, and some power of movement is retained. . . . As a rule, these fractures when treated by rest alone do not heal, and in the course of a few weeks when body-weight is borne, a slight twist or turn results in the breaking-up of the temporary stability. . . . The so called impacted fractures practically always call for the same treatment as other fractures of the neck of the femur."

The careful studies of the vascular supply of the head and neck of the femur by Kolodny, Chandler and Kreuscher, and others have been correlated with the clinical findings of Santos, Phemister, and Murray. Phemister has studied the incidence and means of recognition of necrosis in the head of the femur. He has observed that the necrotic head becomes replaced by new bone if it is protected from weight-bearing. The danger resulting from weight-bearing is further emphasized by Speed (1935), who says: "Weight-bearing or pressure which exists on the head of the bone from the very moment of reduction, or continues on the active process of attempted bone healing, is the one factor which seems understandable as leading to delayed non-union, aseptic necrosis of the head, and deformity of the hip with joint changes."

The disturbance of the blood supply is definitely related to the level of the fracture, as is shown graphically by Murray (Fig. 1), and to the displacement of the fragments with accompanying injury to the capsule. In an impacted subcapital or high cervical fracture, the head may have as its only blood supply the artery of the ligamentum teres until the injured vessels at the site of the impaction have become reestablished. This would seem to make the impacted subcapital fracture very prone to non-union or to necrosis of the head.

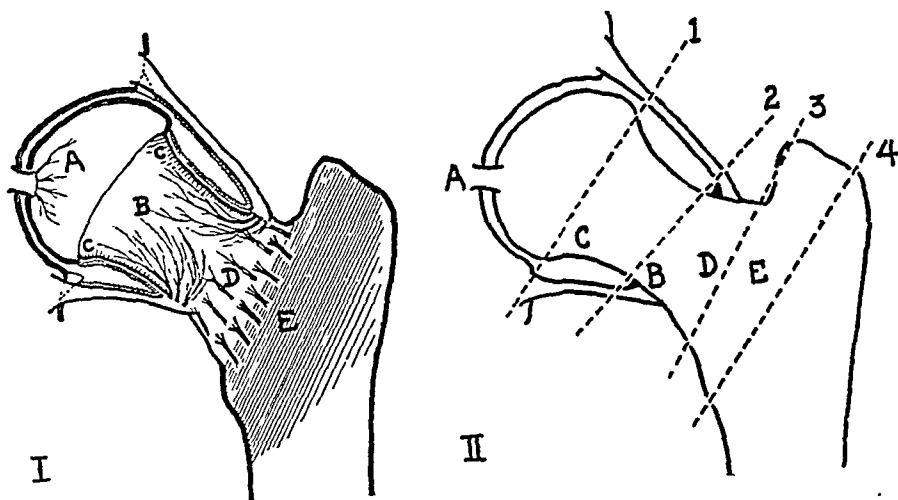


FIG. 1

*I* = Sources of blood supply for the femoral neck. *A*: from the ligamentum teres, scant and sometimes missing; *B*: from the capsular attachments, numerous large vessels; *C*: from the capsular reflection and synovia, small short vessels; *D*: nutrient vessels, numerous and good-sized; *E*: from the extensive muscle attachments in intertrochanteric region (shaded area). In the intact femur these vessels anastomose freely.

*II* = Effect of fracture on blood supply to the proximal fragment. Assuming the fracture to be complete in each instance, the proximal fragment retains after:

- Fracture 1—blood supply *A* only;
- Fracture 2—blood supply *A* plus *C*;
- Fracture 3—blood supply *A* plus *B* plus *C* plus *D*;
- Fracture 4—blood supply practically intact.

(This illustration, which appears as Fig. 324 in the second edition of "A Textbook of Surgery", edited by Frederick Christopher, is reproduced through the courtesy of Dr. Clay Ray Murray and the W. B. Saunders Company.)

Notwithstanding these observations, it is a general principle that non-use of bone promotes its atrophy and that use stimulates its growth and strength. The stimulus of function often has a very favorable influence on the rate of healing of other fractures.

It would seem desirable to observe the effect of the stimulus of function on the healing of an impacted fracture of the femur. This thought was stimulated by the valuable work of Apfelbach and Aries, who reported twenty-two cases of complete fracture of the neck of the femur, in seventeen (77 per cent.) of which union occurred. In each case the authors anaesthetized the patient, reduced the fracture by manipulation, and artificially impacted the fragments by the Cotton method. A single plaster spica, which included the pelvis and extended to the toes, with the

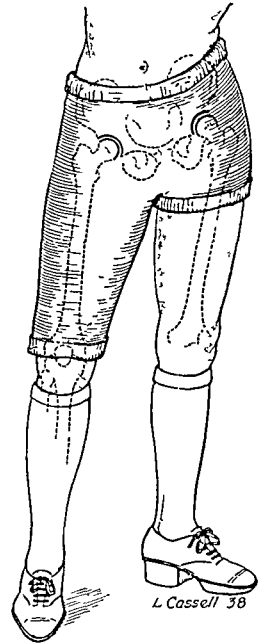
leg in 30 degrees of abduction and in some internal rotation, was then applied. The pelvis was tilted by considerable elevation of the shoe on the uninjured side, and a walking iron was placed under the cast. The cast was removed after from eight to eighteen weeks.

The ambulatory treatment, if successful, has many advantages. The general health of the patient is greatly improved, and the likelihood of pulmonary complications is greatly diminished. The stimulus of function tends to accelerate repair and prevents bone atrophy. Muscle atrophy is diminished. The patient's frame of mind is very good, and he may actually accomplish considerable work.

If the fracture is definitely impacted, the necessity for maintenance of inversion would seem to be less or even absent. In that event, the cast may end above the knee, thus limiting its function to the maintenance of abduction and permitting motion in inversion, as well as motion in the knee joint.

With these thoughts in mind, the author has treated five patients by the following modification of the method of Apfelbach and Aries, with uniformly good results.

With or without anaesthesia, and with the aid of a Hawley table, a single plaster spica is applied with the femur in wide abduction. The cast, which is patterned after the type used by Smith-Petersen following his nailing operations, is accurately molded about the pelvis and ends just above the knee (Fig. 2). It may be applied with the patient standing. After from one to five days, the patient is permitted to walk with crutches, using a two-inch elevation on the shoe on the well side and an ordinary shoe on the injured side. The patient is encouraged to walk and to discard the crutches as soon as he can do so comfortably. The elevated shoe is employed for two or three months, after which the elevation is gradually reduced.



#### CASE REPORTS

**CASE 1.** Mrs. A. L., aged seventy-seven years, fell on March 2, 1937. Roentgenographic examination at the Evanston Hospital on the next day showed an impacted sub-capital fracture of the neck of the right femur (Fig. 3-A). On March 6, without anaesthesia, a short abduction spica was applied. The patient walked with crutches the next day and without crutches the following day. The hospitalization period was only seven days. The cast was removed on the thirtieth day, but full weight-bearing was prohibited for two weeks more. On June 14, 101 days after application of the cast, roentgenographic examination revealed excellent union. On May 24, 1938, the patient was actually able to run. She was perfectly well when last seen, on August 3, 1939 (Fig. 3-B).

Fig. 2

Diagram of short abduction spica, showing elevation of the heel on the uninjured side. The tilt of the pelvis maintains abduction.

CASE 2. Mrs. A. S. C., aged seventy-five years, fell on May 20, 1937. Pain and disability in the right hip immediately resulted. Roentgenographic examination at the Evanston Hospital on the same day showed an impacted subcapital fracture of the neck of the right femur (Fig. 4-A). On May 21, with the patient under ethylene anaesthesia, a short abduction spica was applied. The patient walked with crutches and an elevation of the heel on the well side on the fourteenth day and soon discarded the crutches. The



FIG. 3-A

FIG. 3-B

Fig. 3-A: Case 1. Mrs. A. L. Impacted subcapital fracture of the neck of the right femur, March 3, 1937.

Fig. 3-B: Appearance on August 3, 1939, twenty-nine months later, showing excellent union.



FIG. 4-A

FIG. 4-B

Fig. 4-A: Case 2. Mrs. A. S. C. Impacted subcapital fracture of the neck of the right femur, May 20, 1937.

Fig. 4-B: Firm union twenty-six months later, August 7, 1939.

cast was removed on the thirty-ninth day, and the elevation of the heel was discarded after about six months. She made a rapid and uneventful recovery. On October 4, roentgenograms showed excellent union and a viable head. Over a year later she was entirely cured. Roentgenograms taken on August 7, 1939, showed complete union (Fig. 4-B).

CASE 3. Mrs. M. S., aged fifty-seven years, a patient of Dr. W. Kenneth Jennings's, fell on December 17, 1937. A roentgenogram, taken at an outside laboratory, showed a fracture of the neck of the right femur. A short plaster spica was applied the next day with the patient under anaesthesia. Roentgenographic examination through the cast on December 23, 1937, showed the fracture (Fig. 5-A). The patient walked with crutches on December 24, and the cast was removed six weeks later, on February 3, 1938. The hospitalization period was ten days. Roentgenographic examination on February 25, sixty-nine days after application of the cast, showed excellent union and a normal femoral head. On June 1, 1938, the patient walked well and was free from pain. On August 30, 1939, a roentgenogram showed complete union (Fig. 5-B), and the patient was perfectly well.

CASE 4. Miss E. T., aged seventy-nine years, fell on the evening of February 27, 1938. Roentgenograms, taken at the Evanston Hospital on the next morning, showed an impacted subcapital fracture of the neck of the right femur (Fig. 6-A). On March 1, with the patient under ethylene anaesthesia, a short abduction spica was applied. The heel of the shoe on the unaffected side was elevated two inches. The patient walked with crutches on the seventh day after the injury and without crutches on the twenty-fifth day. The cast was removed on the forty-second day. Roentgenographic examination on the forty-third day showed union. The elevation of the heel was discarded during the third month. On August 11, 1939, the patient was perfectly well, and the roentgenogram showed complete union (Fig. 6-B).

CASE 5. Mrs. S. C., aged fifty-three years, fell on March 16, 1938. Roentgenographic examination (Dr. C. A. Matthews) on the same day showed fracture of the neck of the right femur. A short abduction spica was applied on March 18 without the use of an anaesthetic (Fig. 7-A). The patient walked with crutches on the seventh day and without crutches on the tenth day. The hospitalization period was eleven days. The cast was removed on the fifty-second day, and roentgenographic examination on the



FIG. 5-A

FIG. 5-B

Fig. 5-A: Case 3. Mrs. M. S. Impacted fracture of the neck of the right femur, December 23, 1937.

Fig. 5-B: Firm union twenty months later, August 30, 1939.

sixty-eighth day showed union and a normal head. Thereafter the patient recovered rapidly. On August 7, 1939, she was entirely well, and the roentgenogram taken at that time showed complete healing (Fig. 7-B).

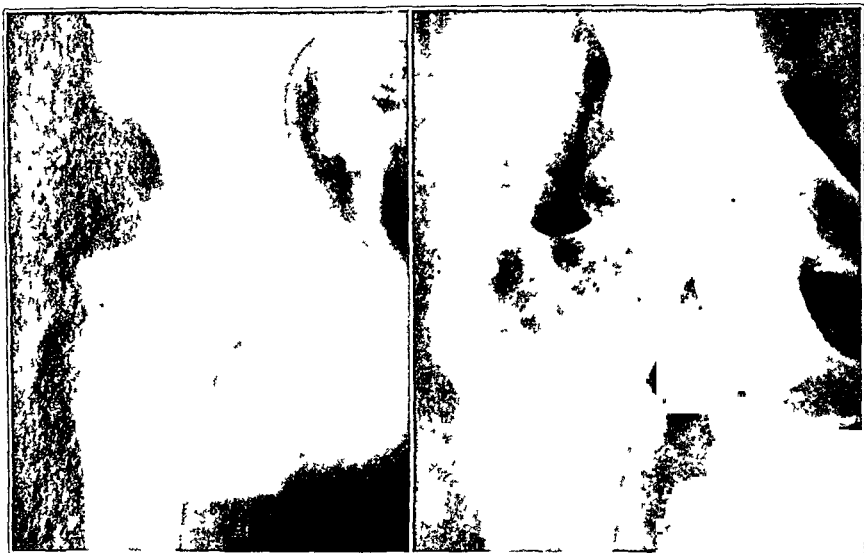


FIG. 6-A

FIG. 6-B

Fig. 6-A: Case 4. Miss E. T. Impacted subcapital fracture of the neck of the right femur, February 28, 1938.

Fig. 6-B: Excellent union seventeen months later, August 11, 1939.



FIG. 7-A

FIG. 7-B

Fig. 7-A: Case 5. Mrs. S. C. Impacted subcapital fracture of the neck of the right femur, March 18, 1938 (roentgenogram taken through spica).

Fig. 7-B: Firm union sixteen months later, August 7, 1939.

This series of cases is too small to offer conclusive evidence. However, the uniform clinical success, the excellent roentgenographic appearance over a year after the accident, and the ease and convenience of the treatment seem to warrant this report.



## SUMMARY

In the five cases of impacted fracture of the neck of the femur reported, treatment by means of a short abduction spica, elevation of the heel of the shoe on the well side, and early walking resulted in union and complete recovery.

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# THE IMPORTANCE OF ACCURATE ROENTGENOGRAPHY AND INTERPRETATION IN FEMORAL-NECK FRACTURES TREATED BY INTERNAL FIXATION

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The purpose of this paper is to reemphasize the importance of exercising great care in the making and interpretation of roentgenograms at the time when the nail, bolt, or pin is inserted. The following roentgenograms and photographs illustrate this need.

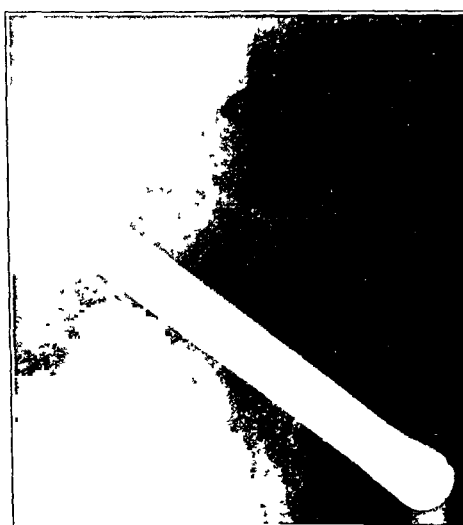


FIG. 1-A

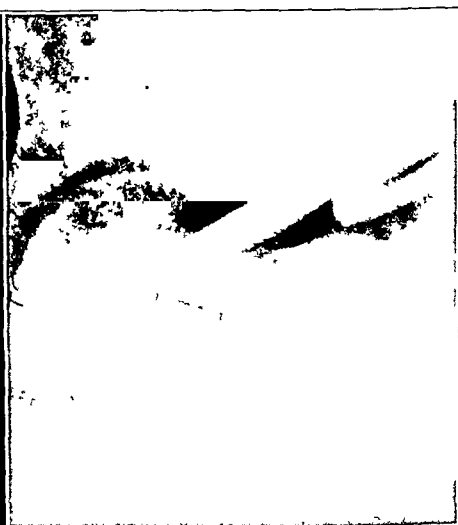


FIG. 1-B



FIG. 1-C



FIG. 1-D



FIG. 2-A



FIG. 2-B

Figures 1-A and 1-B are anteroposterior and lateral views taken in the operating room. With the patient lying on a cassette box, the lateral view was obtained by flexing the thigh to 90 degrees. In the anteroposterior view the nail appears to be placed somewhat low, but seems to penetrate the head satisfactorily. Before the patient left the operating room, the leg was placed on a Braun splint, so that the nail could not have been dislodged through trauma if it had been in the head as it appears to be in the roentgenograms. Some three hours later, it was noted that the extremity had become shortened and externally rotated. Figures 1-C and 1-D show the position of the fragments and the nail at that time.

It is obvious that the nail *did not penetrate the head at the time when it was inserted*.



FIG. 2-C



FIG. 2-D

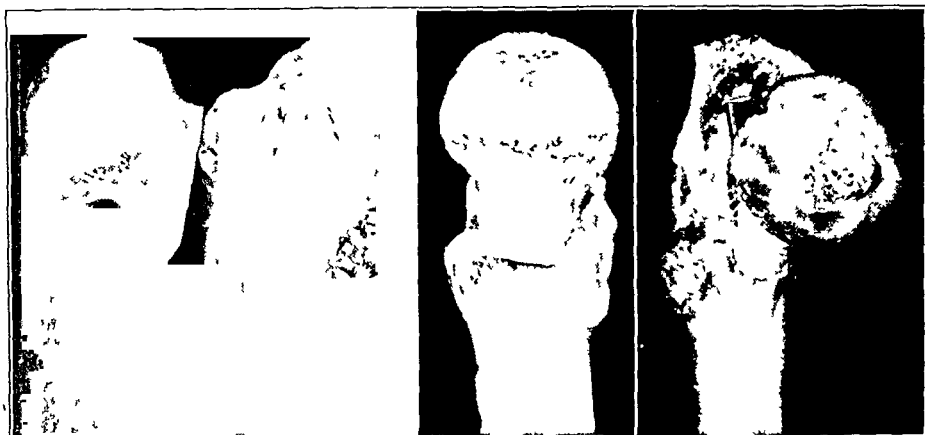


FIG. 3-A

FIG. 3-B

FIG. 3-C



FIG 3-D

FIG. 3-E

*Explanation:* The nail passes through the neck, but comes out anterior to the head. An anteroposterior view gives the impression that the tip of the nail actually penetrates the head. As the nail passes inward along the anterior surface of the head, the fragments

disengage, due partly to rotation of the head. When the thigh is flexed to 90 degrees (for the lateral roentgenogram), the nail rotates, and, although it actually lies on the anterior surface, it has the roentgenographic appearance of being in the head.

Figures 2-A and 2-B are roentgenograms taken in the operating room. These were apparently satisfactory. Figures 2-C and 2-D are films taken the next day. The extremity had been placed on a Braun splint in the operating room.

It is obvious that the nail *did not enter the head at the time of operation.*

*Explanation:* The reason for the misleading appearance of the first roentgenograms is the same as in the first case, except that the nail passed posterior to the head.

Figures 3-A, 3-B, and 3-C—anteroposterior, lateral, and oblique photographs of a fractured femoral neck—show the nail penetrating the neck, but lying posterior to the head. Figures 3-D and 3-E are roentgenograms of the same specimen.

#### SUMMARY

The illustrations which have been presented demonstrate the danger of using the "flexed-thigh position" to obtain the lateral view. This method of taking the lateral view is not recommended.

# DYSOSTOSIS MULTIPLEX

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In 1931, Helmholz and Harrington called attention to a syndrome characterized by congenital clouding of the cornea, scaphocephalic head, kyphosis, limited extension of the joints of the extremities, and other anomalies. Previously, similar cases had been described by Hurler, Jewesbury and Spence, and Putnam and Pelkan. It was the opinion of Helmholz and Harrington that this syndrome should be regarded as an addition to the group of clinically well-defined syndromes previously described, in which cranial dysostosis and other abnormalities were outstanding features. In 1933, Binswanger and Ullrich reported two such cases and chose to name the syndrome "dysostosis multiplex". Gasteiger and Liebenam reported a case of dysostosis multiplex in one of binovular female twins. These cases are of interest chiefly because of their extreme rarity. The condition is a subvariety of chondrodystrophy. Its features are: dwarf stature; the combination of scaphocephalic and chondrodystrophic deformities of the skull; chondrodystrophic changes in other parts of the skeleton, which give rise to shortness of the neck and trunk, protrusion of the abdomen, kyphosis of the spine, and partial ankylosis of the joints; and a non-skeletal abnormality, clouding of the cornea.

The authors wish to present an additional case of dysostosis multiplex, in which certain observations of the eyes and roentgenographic studies of the skeletal system have been made, which we believe have not been included in previous reports.

## CASE REPORT

R. S., female, sixteen months old, was referred to the authors on May 27, 1939, because of a marked kyphosis and general weakness. The father, aged twenty-six, and the mother, aged thirty, were alive and well. There was no consanguinity in the parents as far as was known. There had been three other pregnancies; the other children were normal boys, whose ages were seven, four, and three years, respectively. There was no family history of deformity of the head, spine, or eyes, nor any history of chronic familial disease. The patient had been born at term after a normal pregnancy. She had been delivered normally and at birth weighed seven and one-half pounds. Primary respirations had been satisfactory, and there had been no cyanotic spells. The first teeth had appeared at nine months, and the patient had sat alone at about the same age. She had never stood alone or pulled herself up from a sitting position. Recently she had said a few simple words. She had been breast-fed from birth, and the hours of feeding had been irregular. Her diet had been poor, and she was a capricious eater. Cod-liver oil had not been given before fifteen months of age, and orange juice had been given irregularly after seven months of age. Other children in the family had apparently developed normally



FIG. 1

Showing the cretinoid appearance. A suggestion of cloudy cornea is present in the picture.



FIG. 2

Note the kyphosis, scaphocephalic head, and wide wrists. The elbows and knees do not extend completely.

on a similar diet. The kyphosis had been present at birth, and the head had seemed large. The parents had noted that the fontanel was open, and in recent months they had observed a peculiar opacity of the corneas. The patient's vision had seemed adequate. In their opinion, her general development had been retarded.

The child somewhat resembled a cretin (Fig. 1). She was short and thickset. Her height was twenty-eight and a half inches (sixty-two centimeters) and her weight, twenty and a quarter pounds (eight kilograms). The head was scaphocephalic, with a circumference of fifty-one centimeters and an anteroposterior diameter of nineteen centimeters. The anterior fontanel was open and measured five and five-tenths by four and five-tenths centimeters. The hair was dry and fine and sparse in the occipitoparietal



FIG. 3

Note the marked thickening of the ribs.

region. The forehead was prominent and overhanging. The eyes were prominent, and the corneas had a cloudy appearance. The nose was saddle-shaped, and the ears were large and low-set. The features were coarse, and the lips seemed thickened. The patient had five teeth—three uppers and two lowers—all poorly erupted and arising from knotty, ridged gums. The neck was short, and the child sat in a hunched manner, due to the deformity of the spine. The thorax seemed thickened, and there was a slight costal flare. The abdomen was protuberant, and there was marked kyphosis (Fig. 2). Extension of the elbows and abduction of both shoulder joints were limited. The hands were pudgy, but showed no limitation of extension in the fingers. The wrists were flat and widened. The skin generally was flabby and of poor turgor, and considerable fine hair was noted about the shoulders and the upper back. Scabietic lesions were present on the upper trunk. The

reflexes were normal, and the patient seemed to hear and to see satisfactorily. She was irritable and frightened, and her mental development seemed retarded for her age.

Urinalysis was negative. The blood count was as follows:

Red blood cells—	3,370,000
Hemoglobin—	53
White blood cells—	7,150
Polymorphonuclear neutrophils—	40.5 per cent.
Lymphocytes—	57.0 per cent.
Monocytes—	2.0 per cent.
Eosinophiles—	0.5 per cent.

The blood calcium was 11.5 milligrams; the phosphorus, 4.3 milligrams; and the cholesterol, 170 milligrams. The blood Kahn and Rytz tests were negative. The Mantoux test, with 0.1 milligrams of old tuberculin, was negative.

More complete examination of the patient's eyes by the ophthalmologist showed no apparent visual difficulty. The corneas of the eyes seemed larger than normal, but measured only twelve millimeters in diameter. Both corneas showed a diffuse clouding, apparently interstitial. There was no photophobia or evidence of intra-ocular inflammation. The corneas did not stain with fluorescein, and there were no deposits on Descemet's membrane. The pupils were three millimeters in diameter and reacted to light and to convergence. They dilated poorly with homatropine, but there were no synechiae. Intra-ocular tension (under ether anaesthesia) was 25 on the right and 22 on the left. Ocular rotation was normal. Because of the cloudy corneas and the lack of cooperation, it was impossible to visualize the fundi.

Roentgenographic studies of the chest showed very marked thickening of the ribs, due to subperiosteal deposition of new bone, and a marked clubbing of their sternal ends (Fig. 3). The thickening of the ribs was approximately twice that of a normal child of the same age. There were chondrodystrophic changes in the upper ends of the humeri. The wrists showed two centers of ossification. Chondrodystrophic changes were present in the lower epiphyses of both bones of the forearms, with marked periosteal elevation of the bones of the metacarpi, the radii, and the ulnae. The distal ends of the radii and the ulnae were enlarged and slightly cupped (Fig. 4). Similar chondrodystrophic changes were found in the lower femoral epiphyses. Periosteal elevation was present along the shafts of the bones of the legs. The diaphyses of all of the long bones were rather square. Lateral roentgenograms of the spine showed kyphosis, due to shortening of the body of the first lumbar

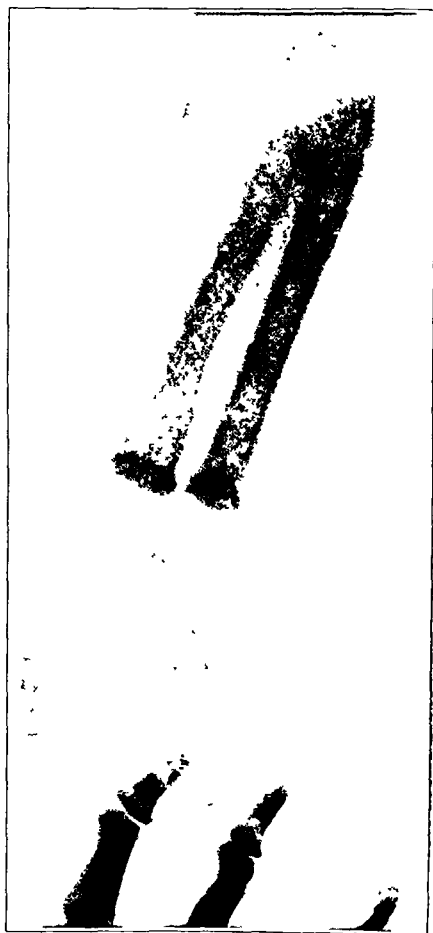


FIG. 4

Cupping of the distal end of the radius and the ulna can be noted, also apparently growth-arrest lines in the metacarpal bones. Periosteal elevation is noticeable along the radius and the ulna.

vertebra in the anteroposterior diameter, with some wedging and slipping forward of the body of the twelfth thoracic vertebra (Fig. 5). The skull showed a widely open anterior fontanel.

#### COMMENT

There may be speculation as to whether the periosteal and epiphyseal

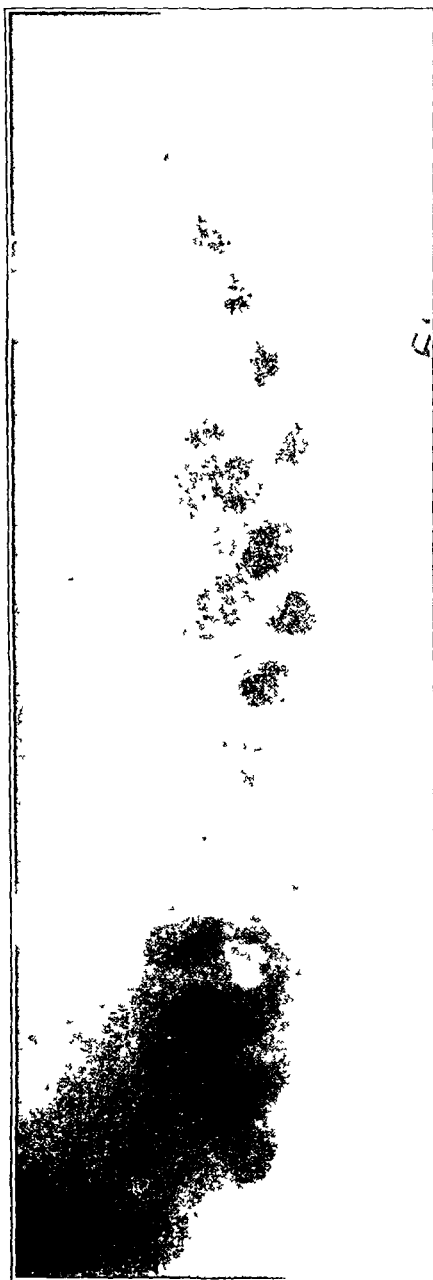


FIG. 5

The spine shows kyphosis, due to the shortening of the body of the first lumbar vertebra, with wedging and slipping forward of the twelfth thoracic vertebra.

changes observed in the skeletal system were primarily congenital or secondary to vitamin deficiency. The periosteal changes producing the peculiar "squaring" of the bones were previously noted by Putnam and Pelkan. In the authors' opinion, the changes in the bones are evidence of florid rickets and possibly of subclinical scurvy; the latter may be questionable. The failure to give cod-liver oil and the irregular and inadequate administration of citrous fruits make this supposition likely. Moreover, the roentgenographic picture of cupping of the ends of the long bones and the hazy, moth-eaten appearance of the epiphyses would substantiate the diagnosis of rickets.

For one month prior to the patient's admission to the Clinic, she had been given a form of fish-liver oil, rich in vitamin D. Because of this, it is likely that what appears to be periosteal elevation of the metacarpal bones may actually be growth-arrest lines with increased osseous activity, following administration of the vitamin D. Despite the clinical and roentgenographic evidence of rickets and the probable increased osseous activity subsequent to high vitamin-D intake, it is realized that a primary defect in enchondral ossification exists in such patients, since they are all short and squat. Consequently, the roentgenographic changes noted in the epiphyses are probably a combination of both rickets and the primary disease with which the child was congenitally afflicted.



There is some similarity between the syndrome described herein and Morquio's disease (osteochondrodystrophia deformans). In the literature it seems not unlikely that certain cases<sup>3</sup> of dysostosis multiplex may have been falsely termed Morquio's disease. The latter condition is usually not recognized at birth, so that development during infancy may appear to be entirely normal until the time of walking. Morquio, Meyer and Brennemann, and Barnett made no mention of cloudy cornea in Morquio's disease. Moreover, in most cases of that condition, the skull is of normal contour, and genu valgum is present. Morquio's disease is usually familial, and most often the mentality of the patient is normal. In contrast to these findings, dysostosis multiplex is characteristically (1) congenital, (2) associated with cloudy cornea and scaphocephaly, and (3) accompanied by generally retarded mentality.

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vertebra in the anteroposterior diameter, with some wedging and slipping forward of the body of the twelfth thoracic vertebra (Fig. 5). The skull showed a widely open anterior fontanel.

#### COMMENT

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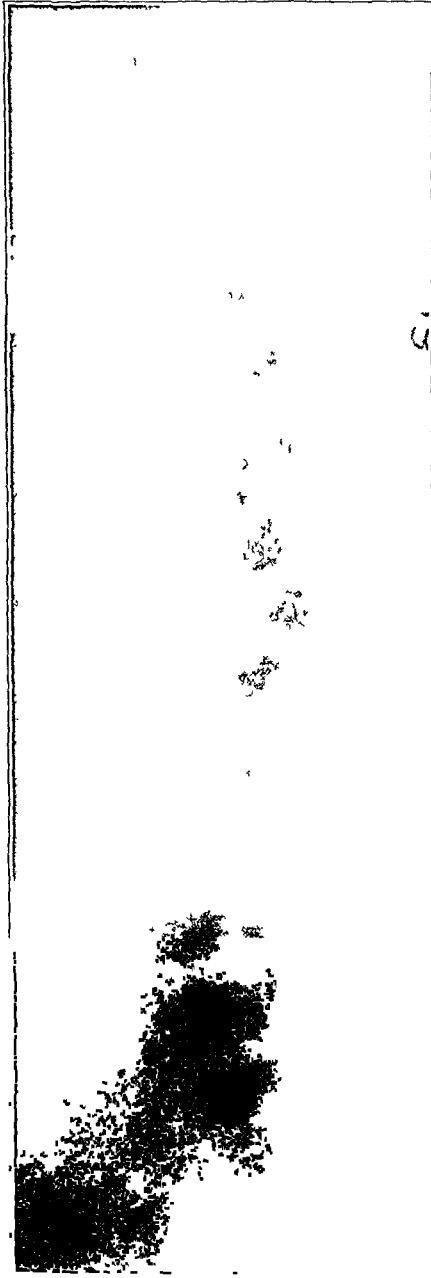


FIG. 5

The spine shows kyphosis, due to the shortening of the body of the first lumbar vertebra, with wedging and slipping forward of the twelfth thoracic vertebra

changes observed in the skeletal system were primarily congenital or secondary to vitamin deficiency. The periosteal changes producing the peculiar "squaring" of the bones were previously noted by Putnam and Pelkan. In the authors' opinion, the changes in the bones are evidence of florid rickets and possibly of subclinical scurvy; the latter may be questionable. The failure to give cod-liver oil and the irregular and inadequate administration of citrous fruits make this supposition likely. Moreover, the roentgenographic picture of cupping of the ends of the long bones and the hazy, moth-eaten appearance of the epiphyses would substantiate the diagnosis of rickets.

For one month prior to the patient's admission to the Clinic, she had been given a form of fish-liver oil, rich in vitamin D. Because of this, it is likely that what appears to be periosteal elevation of the metacarpal bones may actually be growth-arrest lines with increased osseous activity, following administration of the vitamin D. Despite the clinical and roentgenographic evidence of rickets and the probable increased osseous activity subsequent to high vitamin-D intake, it is realized that a primary defect in enchondral ossification exists in such patients, since they are all short and squat. Consequently, the roentgenographic changes noted in the epiphyses are probably a combination of both rickets and the primary disease with which the child was congenitally afflicted.

There is some similarity between the syndrome described herein and Morquio's disease (osteochondrodystrophia deformans). In the literature it seems not unlikely that certain cases<sup>3</sup> of dysostosis multiplex may have been falsely termed Morquio's disease. The latter condition is usually not recognized at birth, so that development during infancy may appear to be entirely normal until the time of walking. Morquio, Meyer and Brennemann, and Barnett made no mention of cloudy cornea in Morquio's disease. Moreover, in most cases of that condition, the skull is of normal contour, and genu valgum is present. Morquio's disease is usually familial, and most often the mentality of the patient is normal. In contrast to these findings, dysostosis multiplex is characteristically (1) congenital, (2) associated with cloudy cornea and scaphocephaly, and (3) accompanied by generally retarded mentality.

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# UNREDUCED UNILATERAL DISLOCATION OF THE JAW

## OPERATIVE CORRECTION AFTER FOUR YEARS

BY MARCUS SCHWARTZ, M.D., WHITE PLAINS, NEW YORK

Dislocation of the jaw, according to Stimson, comprises about 3 per cent. of all dislocations, and, according to Speed, about 1.5 per cent. Campbell, in Lewis's "Practice of Surgery", states that an unreduced dislocation is rare, because the disability is so great and the appearance is so unsightly, particularly in the bilateral type, that the patient immediately seeks relief. Rarely a unilateral dislocation may remain unreduced, but even this is quite deforming, and aid is sought at once. Reports in the literature of long-standing, unreduced, bilateral or unilateral dislocations requiring open operation are rare.

Willcutts reports the case of a man who was operated upon under general anaesthesia for an infection of the neck. When the patient regained consciousness, he had difficulty in closing his mouth, which was thought to be due to the operative procedure. When the condition persisted, some infected molar teeth were believed to be the cause, but their removal did not help matters. Not until three months later was the condition recognized as an unreduced bilateral forward dislocation. It was successfully treated by open reduction under block anaesthesia.

Lane reports a case of unilateral dislocation of the lower jaw of several weeks' duration, which was treated by open operation. The intra-

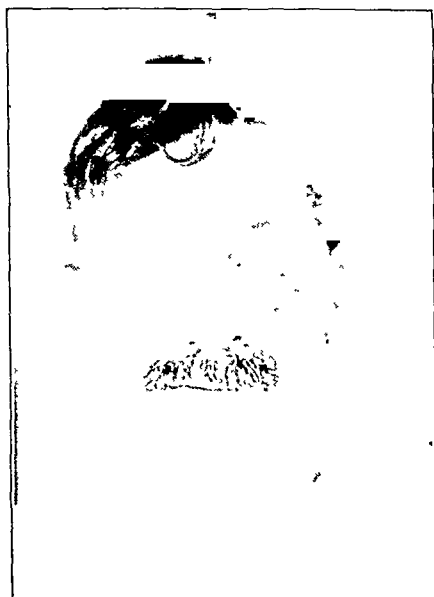


FIG. 1-A



FIG. 1-B

Photographs before reduction. With the mouth closed, the chin is deviated to the right, the left jaw being dislocated. When the mouth is open, the chin is in the mid-line, for the right (normal) mandibular condyle glides forward and rests under the articular tubercle.

articular fibrocartilage was found to have buckled and to have projected outward from between the bones. It was replaced and fixed to the bone above with silver wire.

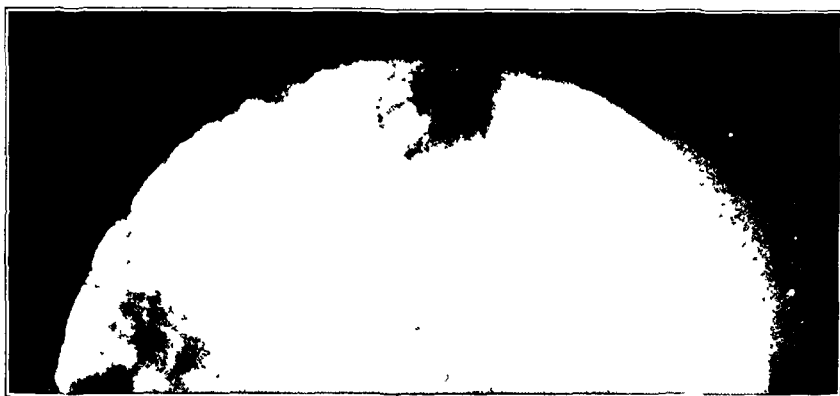


FIG. 2-A

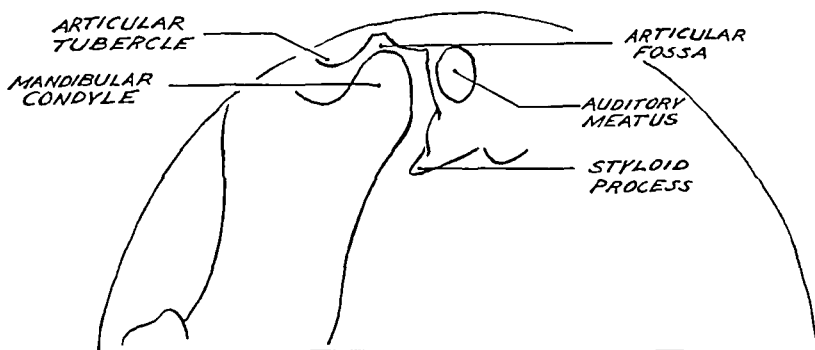


FIG. 2-B

Print and tracing of roentgenogram of right temporomandibular joint transposed to appear like the left.

Before reporting an additional case, the author feels that the anatomy of the temporomandibular joint should be reviewed. This joint is composed of an articular fossa in the temporal bone, in front of which is the articular tubercle. The condyle of the mandible fits into this fossa. An intra-articular disc, attached to the joint capsule, separates the fossa from the condyle. Actually there is a joint space above the disc and one below it. The internal and external lateral ligaments reinforce the capsule on either side of the joint, and a strong stylomandibular ligament extends from the styloid process of the skull to the ramus of the mandible. The four muscles involved in the motion of the joint are the temporalis, the masseter, and the internal and external pterygoids.

Being a ginglymo-arthro-dial joint, it has both hinge-like and gliding motion. Thus, when the jaw opens, it acts as a hinge, and the condyle glides forward until it rests under the eminentia articularis or articular

tubercle, the intra-articular fibrocartilage gliding forward with the condyle. This type of motion results, because, due to the attachment of the stylomandibular ligament, the axis of the hinge is not at the condyle, but at a point below it.

The following case is of almost four years' duration and was treated by open reduction under general anaesthesia.



FIG. 3-A

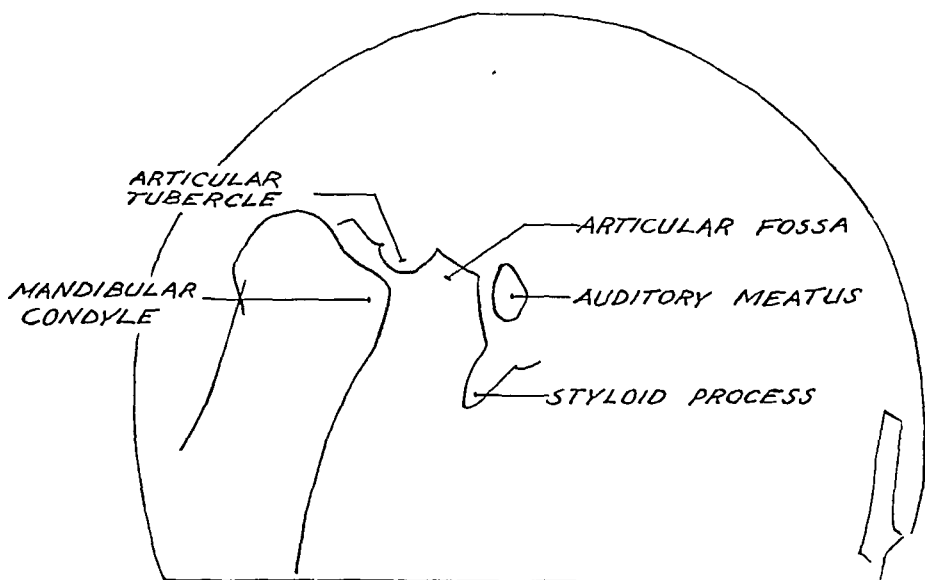


FIG. 3-B

Print and tracing of roentgenogram of left temporomandibular joint before operation. The condyle of the mandible is anterior to the articular tubercle. The tip of the styloid is three-quarters of an inch from the ramus of the mandible.

Four years before presenting himself for treatment, the patient fell from a scaffold and sustained a blow on the lower jaw. The pain and disability were not very severe at the time, but thereafter the patient began to notice a progressively increasing deviation of the jaw to the right and difficulty in chewing. As in the case reported by Willcutts, it was thought that this was caused by bad teeth, and three teeth were extracted. This did not help matters, and the patient still had difficulty in eating.

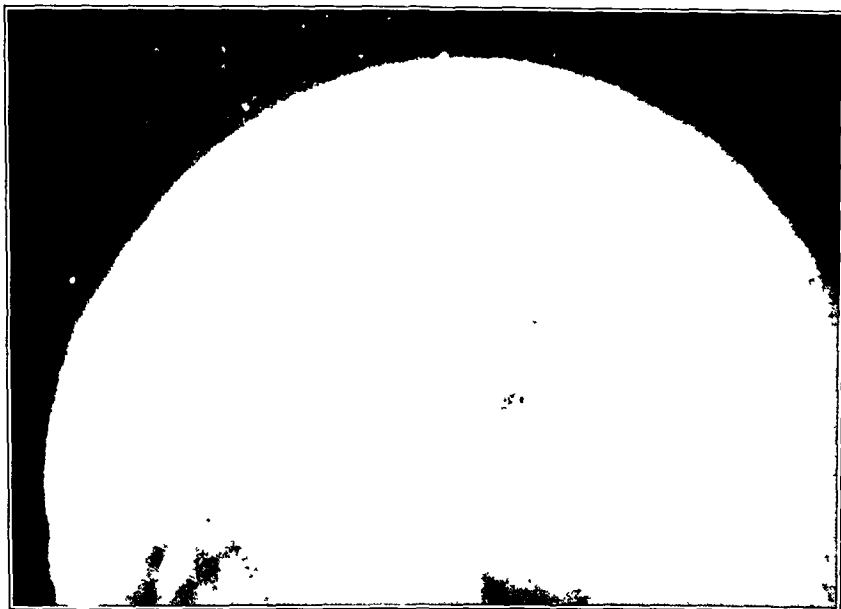


FIG. 4-A

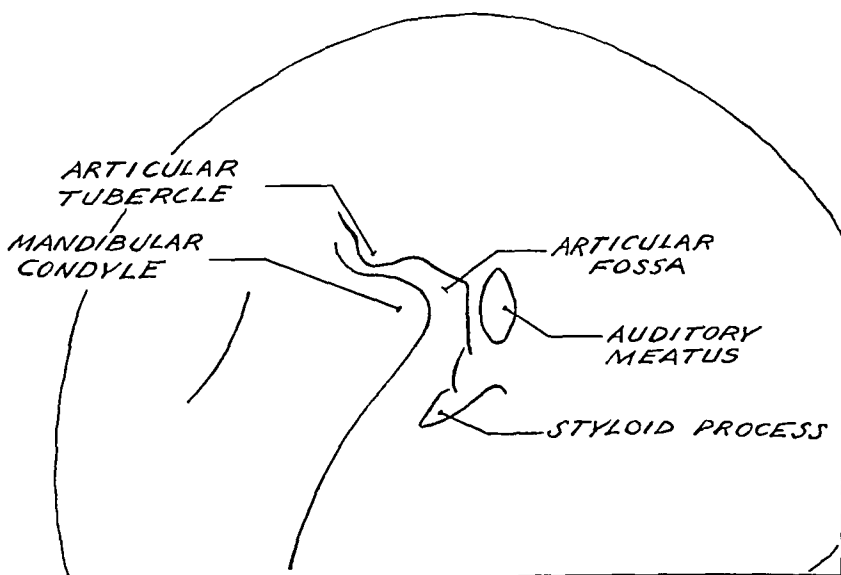


FIG. 4-B

Print and tracing of roentgenogram of left temporomandibular joint taken ten days after operation. The condyle of the mandible is in the articular fossa and behind the articular tubercle. It is not in quite as deep as is that on the right (normal) side. The tip of the styloid is three-eighths of an inch from the ramus of the mandible.

Examination of the patient demonstrated the dual motion in the jaw. With the mouth closed, the left mandibular condyle being dislocated anteriorly, the chin was forward and deviated to the right (Fig. 1-A). As the patient opened his mouth, the chin swung toward the mid-line, and his face looked quite symmetrical (Fig. 1-B). This was due to the fact that, as the mouth opened, the right mandibular condyle moved under the articular tubercle,—in a position similar to that in which the left condyle was fixed.

With the exception of one point in the vicinity of the incisor teeth, there was practically no dental occlusion. The teeth were carious, due to disuse.

Roentgenographic examination showed the left mandibular condyle to be fixed anterior to the articular tubercle instead of behind it, as shown in the roentgenogram of the right temporomandibular joint, which was taken for comparison. The distance between the tip of the styloid and the ramus of the mandible, as seen in the roentgenogram, was three-quarters of an inch on the left side and one-eighth of an inch on the right. (See Figures 2-A, 2-B, 3-A, and 3-B.)

Under avertin, supplemented by intra-

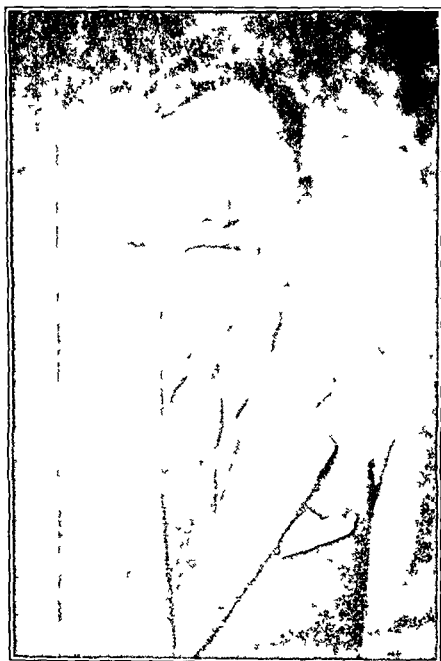


FIG. 5-A

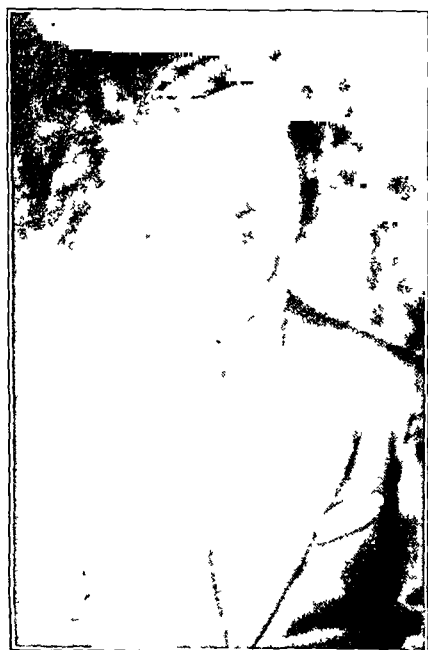


FIG. 5-B



FIG. 5-C

Photographs two years after reduction. The chin is slightly deviated to the right (the left mandibular condyle is not quite as deep in the articular fossa as is the right). The teeth occlude well (of course, these are dentures). The mouth opens well. The facial paralysis has cleared up; forehead wrinkles and the wrinkles about the mouth are clearly visible.



tracheal ether anaesthesia, an attempt was made to force the joint back into position. This was impossible, and an open operation was decided upon. A three-centimeter linear incision was made on a line extending from the external auditory meatus toward the nostril, the incision starting five-tenths of a centimeter from the meatus. The branches of the facial nerve were pulled aside by retractors. The joint was exposed, and, as the capsule was opened, there popped out a smooth, cartilaginous, disc-like, free body, about five-tenths of a centimeter in diameter, very similar to a joint mouse. This was subsequently determined to be the old intra-articular fibrocartilage. (In the case reported by Lane, the buckling of this cartilage prevented closed reduction.) The articular fossa was filled with fibrous tissue, which was removed, but the condyle could not be replaced. It was then found that an exostosis from the neck of the condyle impinged on the articular tubercle and prevented reduction. When this was chiseled away, the condyle was manipulated back into place without difficulty. As soon as this was done, the anaesthetist reported that the teeth occluded properly. It was felt that, since nothing had been done to the condyle, it would be unnecessary to interpose a membrane to prevent ankylosis. The wound was closed without drainage, and a Barton bandage was applied to keep the jaw in position. Two days later, after all postoperative nausea had subsided, the upper and lower teeth were wired together to immobilize the jaw. This was done by Dr. Alvin Berman, who cooperated in the dental care of the patient.

On the day after the operation, it was noted that a facial paralysis had developed, with an inability to wrinkle the forehead, to close the eye, or to draw up the corner of the mouth on the left side. It was felt that this paralysis was probably due to pressure of the retractors rather than to the severance of any of the branches of the facial nerve. Almost a year elapsed before the paralysis had completely disappeared, and during that time the patient had to wear glasses to prevent lagophthalmus. Roentgenograms taken ten days after operation showed that the left condyle was behind the articular tubercle. It was, however, not quite as deep in the fossa as was the condyle on the right or normal side. The distance of the tip of the styloid from the ramus of the mandible was three-eighths of an inch as compared to the previous three-fourths of an inch (Figs. 4-A and 4-B).

The jaws were kept wired together for two weeks, after which motion was begun. The jaws were forced apart daily by means of a dental gag. After four weeks, all the remaining teeth were removed, and the patient was immediately fitted with upper and lower plates. Stretching of the jaw was continued for six months. Two years after the operation (Figs. 5-A, 5-B, and 5-C), the patient was able to open his mouth a distance of one and one-quarter inches between the incisors of the upper and lower plates. (The average mouth opens from one and three-quarters to two inches.) The bite was strong, and the patient was able to chew well. With the mouth closed, the chin was practically in the mid-line. There was no evidence of facial paralysis.

#### SUMMARY

This case of unreduced unilateral dislocation of the jaw, of four years' duration, was treated by open reduction under general anaesthesia. A complicating facial paralysis required almost a year to clear up.

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## AN UNUSUAL SHOULDER LESION

BY EDWIN N. CLEAVES, M.D., F.A.C.R., BOSTON, MASSACHUSETTS

In a book entitled "Localized Rarefying Conditions of Bone as Exemplified by Legg-Perthes' Disease, Osgood-Schlatter's Disease, Kümmell's Disease and Related Conditions", published in 1935, E. S. J. King of Melbourne, Australia, discussed the various locations of osteochondritic lesions and described in detail the lesions themselves.



FIG. 1



FIG. 2

Recently the author happened upon a case which he believed to be an example of osteochondritis of the apophyses of the acromioclavicular processes of the scapulae. This may be a rare condition, or it may be a common one which has not been brought to light, due to its relatively mild nature. When Osgood reported the disease of the tibial tubercle which bears his name, it was supposed to be a rare condition, but, since his report was made, many cases have been recorded.

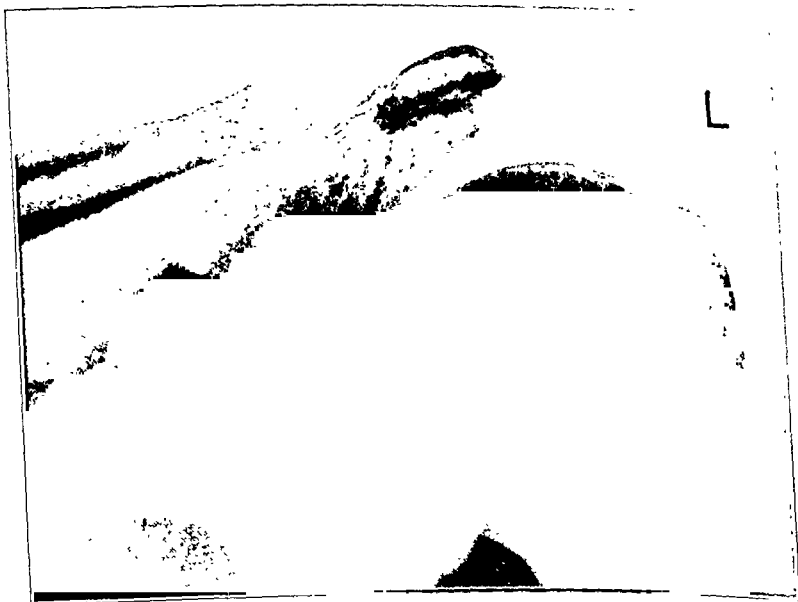


FIG. 3

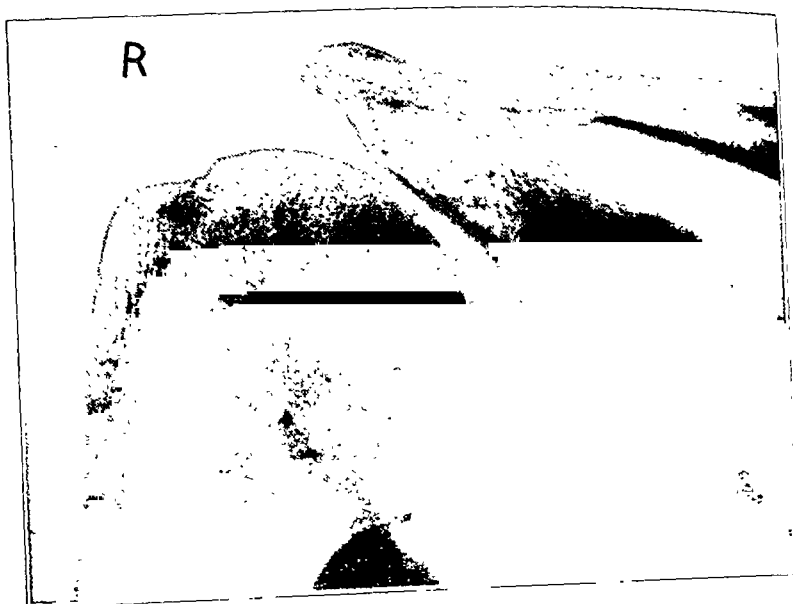


FIG. 4

Since King did not mention osteochondritis of the apophyses of the acromion processes of the scapulae, and since a review of the literature has failed to disclose the report of such a condition, the author feels that the following case should be recorded.

The patient was a young man, seventeen years of age, who, six weeks previously, had injured the right shoulder in a baseball game while sliding into a base. As he fell, he hit the right elbow, but felt pain in the shoulder. He continued in the ball game for two innings, but then had to give up, because it hurt him to throw the ball. Roentgenographic examination demonstrated no fracture or dislocation, but both shoulders showed changes in the apophyses of the acromion processes. The apophyses were smaller than normal, irregular in shape, and showed increased density. The density was irregular, similar to that seen in the tibial tubercle in Osgood-Schlatter disease (Figs. 1 and 2). As seen in the axillary views, the density appeared less marked, but fragmentation of the apophyses could be detected. There was no soft-tissue swelling about the apophyses.

Although no definite history of shoulder trouble previous to the injury could be obtained, it was felt that the condition was due to an osteochondritis, and that any symptoms which might have been present were sufficiently mild to be overlooked or disregarded by the patient. The commoner sites for osteochondritis were examined roentgenographically, and the patient was found to be free from lesions except for those of the scapulae.

The patient's signs and symptoms subsided gradually, the only treatment being a slight limitation of athletic activities. When seen a year and four months later, the patient stated that his shoulders gave him no trouble, except after too-strenuous exertion, when there developed a soreness over the tips of the shoulders. Roentgenographic examination (Figs. 3 and 4) showed that the apophyses of the acromion processes were still smaller than normal, slightly irregular, and somewhat more dense than normal. However, they were definitely assuming the appearance of normal bone. The epiphyseal lines were still partly open, but gave evidence of beginning closure.

The author wishes to express his thanks to Dr. Robert B. Osgood, who referred the patient for roentgenographic examination, and who gave him permission to report the case.

#### REFERENCE

- King, E. S. J.: *Localized Rarefying Conditions of Bone as Exemplified by Legg-Perthes' Disease, Osgood-Schlatter's Disease, Kümmell's Disease and Related Conditions.* London, Edward Arnold & Co., 1935.

# GONORRHOEAL ARTHRITIS: A PROPOSED PLAN OF SULFANILAMIDE THERAPY

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The introduction of sulfanilamide has revolutionized the treatment of all types of gonococcal infections. Prior to the advent of this remarkable drug, gonorrhoeal arthritis was treated in a great variety of ways, but, for the most part, the results were disappointing and unsatisfactory. Symptomatic therapy, including bed rest, sedatives, and fixation of the joints, was found to be of little value. Diathermy enjoyed a brief period of popularity, but later proved to be chiefly a supplementary rather than a specific measure. Aspiration and air injection of the joints seemed to hold greatest promise, but faded into the background after the introduction of artificial-fever therapy. For a few years hyperpyrexia was accepted almost universally as the procedure of choice and was acclaimed by some to be of even greater value than the discovery of the gonococcus by Neisser. Enthusiasm for this type of treatment has waned considerably in many centers, because of serious complications and an occasional death. In a recent paper <sup>7</sup> we have shown that intravenous mercurochrome is of great value in gonorrhoeal arthritis and should be employed more commonly.

Although a voluminous literature concerning sulfanilamide has accumulated, the value of the drug in gonococcal arthritis has been mentioned only incidentally by most investigators. Only recently has attention been directed toward the joint pathology *per se*.

Colston, Dees, and Harrill <sup>6</sup> mentioned ten cases of gonorrhoea with arthritis in which the patients were treated with sulfanilamide, and all showed amazing improvement. Alyea, Daniel, and Harris <sup>2</sup> reported six cases in their discussion of complicated gonorrhoea. Bohlman <sup>5</sup> concluded that from 15 to 20 per cent. of gonococcal infections would not respond to sulfanilamide alone and advocated the combination of chemotherapy and air insufflation of the affected joints.

Keefer and Rantz <sup>9</sup> presented very recently the first detailed study of sulfanilamide in gonorrhoeal arthritis and reported fourteen acute cases which showed complete recovery. The infected synovial fluids became sterile within from forty-eight to seventy-two hours, and these authors noted that sulfanilamide diffused into the joint fluid in approximately the same concentration as in the blood. They recommended raising the blood sulfanilamide to at least five milligrams per 100 cubic centimeters to ensure the best results.

The purpose of this study is: (1) to evaluate the results noted in fifty patients with gonorrhoeal arthritis, who received sulfanilamide therapy, and (2) to propose a satisfactory therapeutic regimen which should be efficacious in most cases.

It has been estimated that in from 1 to 3 per cent. of all cases of gonorrhoea arthritic complications develop. The differential diagnosis of the arthritis is included in most standard textbooks and general reviews of the subject. Rheumatic fever, metabolic diseases, generalized sepsis, and all forms of infectious arthritis must be considered. In most instances, the gonococcal joints can be recognized by: (1) a carefully taken history, which usually reveals a transient polyarthritis that quickly subsided, but later settled in one or more joints; (2) the classic signs and symptoms,—namely, pain, tenderness, local heat, redness, swelling, limitation of motion, muscle spasm, and fever; (3) the demonstration of the gonococcus in a primary genito-urinary lesion; (4) the culture of the organism from the fluid of an affected joint; and (5) the complement-fixation reaction.

It must be remembered that arthritis has been known to follow gonococcal ophthalmia in the newborn without any urethral infection. Spink and Keefer <sup>11</sup> also found several authentic cases of gonococcal arthritis in patients with no clinical or laboratory evidence of a localized genito-urinary infection. The length of the interval between the onset of urethritis and arthritis may vary considerably and occasionally is several years.

The fifty patients comprising this series fall into two groups: (1) those admitted to the Hospital on the orthopaedic, medical, surgical, gynecological, and urological services (thirty-one patients); and (2) those treated in the orthopaedic Out-Patient Department (nineteen patients). The cases have been unselected except in respect to the type of therapy employed. Only those in which the patients received sulfanilamide more or less exclusively have been included. All patients treated with additional fever therapy, intravenous mercurochrome, or other measures which might confuse the end results have been excluded from the series.

Of the fifty patients studied, thirty-eight were colored, thirty-two were females, and eleven had a history of previous attacks of arthritis. Most of the cases occurred during the second and third decades as shown below:

<i>Decade</i>	<i>No. of Cases</i>
0-9 .....	4
10-19 .....	20
20-29 .....	15
30-39 .....	8
40-49 .....	2
50-59 .....	1

A vaginal or urethral discharge was noted on the initial examination in forty instances and in twenty-eight of these the infecting agent was the gonococcus. Complement-fixation tests were carried out on thirty-three

TABLE I

## SUMMARY OF CASES OF THIRTY-ONE HOSPITALIZED PATIENTS TREATED WITH SULFANILAMIDE

No	Race and Sex	Age (Years)	Previous Arthritis	Time Since Last Discharge	Discharge on Initial Visit	Complement-Fixation Reaction	Joint Culture	Duration of Present Arthritis	Joints Involved	Bone Changes	Total Dosage (Grams)	Days Treated	Blood Sulfanilamide (Milligrams per cent.)	Additional Treatment	Degree of Improvement	Remarks
24 Acute Cases																
1	Colored female	13	Yes	?	Gonococcal	Positive	Not done	5 days	Right knee	Absent	86.4	16	10.0	Cast	Well	Still well 1 month later.
2	White female	15	No	?	None	Positive	Not done	6 days	Left wrist	Absent	105.6	22	11.1	Splint	Well	
3	Colored female	18	Yes	1 year	Gonococcal	Positive	Sterile	3 days	Right ankle, wrist, and knee	Present	57.6	12	9.8	None	Well	Hemoglobin dropped to 69 per cent. Well 1 month later
4	Colored male	38	No	10 days	Gonococcal	Positive	Not done	10 days	Left wrist and knee	Present	32.4	6	7.5	Cast, basking, and massage	Well	
5	Colored female	23	No	2 years	Non-specific	Positive	Not done	5 days	Right wrist and left shoulder	Absent	48.6	9	8.3	None	Well	Hemolytic anaemia. Blood transfusion.
6	White female	25	No	2 months	Non-specific	Positive	Not done	2 weeks	Right knee	Absent	19.2	8	?	None	Well	
7	White male	23	No	6 weeks	Gonococcal	Positive	Not done	2 days	Right thumb	No x-ray	21.6	6	2.8	Hot compresses	Well	
8	Colored female	9	No	2 years	Gonococcal	Negative	Not done	1 day	Right ankle	Absent	30.6	17	?	None	Well	
9	Colored male	19	No	1 month	Gonococcal	Positive	Not done	1 day	Right shoulder	Absent	52.8	11	6.0	Splint for 3 weeks	Well	
10	Colored female	31	No	?	Non-specific	Positive	Not done	2 weeks	Elbows, knees, and wrists	No x-ray	27.0	5	10.1	None	Well	Mild anaemia.
11	Colored female	15	No	?	Gonococcal	Positive	Sterile	4 days	Right hip	Absent	27.0	5	9.8	Traction and diathermy	Well	Hemoglobin dropped to 30 per cent. Three blood transfusions.

TABLE I (Continued)

No.	Race and Sex	Age (Years)	Previous Arthritis	Time Since Last Discharge	Discharge on Initial Visit	Complement-Fixation Reaction	Joint Culture	Duration of Present Arthritis	Joints Involved	Bone Changes	Total Dosage (Grams)	Days Treated	Blood Sulfanilamide (Milligrams per cent.)	Additional Treatment	Degree of Improvement	Remarks
12	Colored male	36	No	2 weeks	Gonococcal	Positive	Sterile	1 week	Right knee	Absent	72.0	10	12.9	None	Well	
13	White female	15	No	?	Non-specific	Positive	Not done	6 days	Left wrist	Absent	90.6	21	11.1	Cast, baking, and passive motion	Well	
14	Colored female	13	No	?	Gonococcal	Positive	Sterile	5 days	Right knee	Absent	87.3	16	10.0	Baking and passive motion	Well	Still well 2 months later.
15	Colored female	8	No	?	None	Not done	Positive	3 days	Right shoulder	Absent	36.0	10	10.0	Baking and massage	Well	
16	Colored female	9	Yes	1 week	Gonococcal	Not done	Not done	4 days	Right wrist	Absent	24.0	5	12.0	Splint	Well	
17	White female	32	No	?	Gonococcal	Positive	Sterile	1 day	Left knee	Present	146.5	33	7.3	Cast	Marked	Hemoglobin dropped to 50 per cent. Two blood transfusions. Slight limitation of motion.
18	Colored female	16	No	?	Gonococcal	Positive	Not done	6 days	Elbows, knees, shoulders, and ankles	Absent	75.6	14	8.3	None	Marked	Slight stiffness persisted.
19	Colored female	36	No	?	Non-specific	Positive	Sterile	7 days	Left knee	Absent	43.2	6	11.8	None	Marked	Slight stiffness persisted.
20	Colored female	13	Yes	?	Gonococcal	Positive	Not done	6 days	Right wrist	Absent	97.2	18	20.0	Splint and diathermy	Marked	Slight stiffness persisted.
21	Colored female	15	Yes	8 years	Gonococcal	Positive	Not done	4 days	Left wrist	Absent	18.0	5	7.3	Cast, baking, and massage	Moderate	Hemoglobin dropped to 20 per cent.



TABLE I (Continued)

22	Colored male	58	Yes	38 years	None	Positive	Sterile	1 day	Left knee	No x-ray	24 0	10	?	None	Moderate	Hemoglobin dropped to 54 per cent. Gonococcus cultured in prostatic secretion.
23	Colored female	18	No	?	Non-specific	Not done	Not done	5 days	Right wrist	Absent	14 4	4	?	Splint, barking, and massage	Slight	Hemoglobin dropped to 40 per cent
24	White male	34	Yes	1 month	Gonococcal	Positive	Sterile	5 days	Knee, ankle, wrist, and shoulder	No x-ray	22 4	3	?	None	Slight	Left Hospital before treatment was completed.

4 Subacute Cases																
25	Colored female	23	No	?	Non-specific	Positive	Sterile	3 weeks	Ankles, knees, and elbows	Absent	48 6	16	5 7	None	Marked	
26	White female	25	No	?	Gonococcal	Positive	Sterile	3 weeks	Right hip	Absent	64 8	18	11 8	Cast for 5 weeks	Marked	
27	White male	26	No	2 years	Non-specific	Not done	Not done	6 weeks	Hip, knee, and both feet	No x-ray	15 4	9	?	None	Slight	Inadequate dosage
28	White male	28	Yes	3 years	None	Positive	Not done	3 weeks	Left foot, knee, ankle, and wrist	Present	14 4	3	5 0	Diathermy	None	Bone changes inadequate dosage.

3 Chronic Cases																
29	White male	30	No	1 week	Gonococcal	Not done	Not done	1 year	Right knee	No x-ray	56 4	14	5 4	None	Marked	Slight stiffness persisted
30	Colored female	17	Yes	8 years	Non-specific	Positive	Not done	5 years	Both wrists, right ankle, and left knee and hip	Present	50 4	14	9 9	Diathermy	Slight	
31	White male	28	No	3 years	None	Positive	Not done	4 months	Right foot and left knee and ankle	Present	11 4	3	5 0	Prostatic massage	None	Drug stopped because of anaemia

of the patients, and only one of the tests was negative. Of the seventeen cases in which the test was omitted, a definite gonococcal exudate in the urogenital tract was noted in twelve, and in two other cases the joint cultures were positive.

The duration of presenting symptoms varied considerably. For the sake of simplicity, all of the cases have been divided arbitrarily into acute, subacute, and chronic groups. All cases in which there were symptoms of two weeks' duration or less have been classified as acute (thirty-six cases). Those of from two weeks' to two months' duration have been called subacute (ten cases). To the chronic group have been relegated all cases in which joint symptoms were present for more than two months (four cases).

In most instances polyarthritides had been noted, but when the patients first visited the Hospital the symptoms usually had been confined to one or more of the larger joints. The following joints predominated in this series: knee, twenty-eight cases; wrist, nineteen; ankle, sixteen; shoulder, nine; elbow, seven; foot, six; hip, five; thumb, one; and metatarsophalangeal, one.

Most writers have been content to classify their end results as cured, improved, or unimproved. Although it is difficult in many instances to determine minor variations in improvement, we feel that a more detailed classification of the results is essential. It seems unfair to include a patient with only slight limitation of motion with one who obtained very little motion, but received definite relief from the treatment. For this reason, the following system of grouping has been adopted:

*Well:* Those patients who were entirely asymptomatic on discharge and presented no joint complaints or limitation of motion when seen later in the Out-Patient Department or when treated for some new condition.

*Marked improvement:* Those patients who continued to have very slight limitation of motion or discomfort.

*Moderate improvement:* Those patients who failed to obtain as much relief or function as the preceding group or who had some degree of recurrence of the same joint complaints after active therapy had been stopped.

*Slight improvement:* Those patients who had very little motion, but showed definite improvement in the joint condition.

*Unimproved:* Those patients who showed no appreciable change in symptoms or degree of motion at the end of the treatment.

The cases of thirty-one patients who were hospitalized during their period of sulfanilamide therapy have been summarized in Table I. Of the twenty-four patients with acute cases in this group, sixteen were discharged well despite bone changes in two instances. Four showed marked improvement and probably would be called "cured" by some investigators, inasmuch as only slight stiffness or limitation of motion

persisted. In all probability, additional physiotherapy would have cleared up some of their residua. In both patients who showed only moderate improvement anaemia developed, and the drug had to be discontinued before the usual amount could be administered. The two patients with slight improvement were treated for only three and four days, respectively. In one instance anaemia prevented additional sulfanilamide therapy, and the other patient refused to stay in the Hospital to complete his course of treatment.

Only four patients with subacute cases were hospitalized. Two of these continued to have slight limitation of motion and were classified as markedly improved. The other two patients responded rather poorly. One of these, however, was given a total of only 15.4 grams, which undoubtedly was inadequate treatment. In the only case in this group in which complete failure resulted, the dosage was inadequate, and roentgenographic examination showed definite bone changes in the joint.

The three hospitalized patients with chronic cases varied considerably in their response to the drug. One was greatly improved when last seen, but the other two had rather marked bone destruction and responded poorly despite blood levels of nine and nine-tenths and five milligrams per 100 cubic centimeters. In the one case in this group in which complete failure resulted, anaemia suddenly developed after three days of sulfanilamide administration, and it was deemed inadvisable to continue this form of therapy.

It is readily admitted that the most satisfactory method for treating patients with sulfanilamide is to hospitalize them. Observations and examinations can be carried out with much more satisfaction both to physician and to patient. The confusion of a busy out-patient service is avoided, and complete routine studies can be employed without inconvenience or difficulty. Unfortunately, hospital facilities are not always available and, as was true in this series, many individuals may have to be treated as out-patients. The cases of the nineteen patients who were treated in the orthopaedic Out-Patient Department have been summarized in Table II.

Of the twelve out-patients with acute cases, only one failed to become entirely asymptomatic. That patient was from another city and, after two weeks of sulfanilamide administration and marked improvement, she was advised to continue the drug under the supervision of her family physician. One patient in this group was a baby, twenty-one months of age, who was cured after receiving only six grams of sulfanilamide over a period of eight days.

Six patients with subacute cases were treated in the Out-Patient Department with excellent results. All but one were discharged well. In the single instance of limited improvement the patient had slight residual stiffness of the joint and was advised to have additional diathermy, but he apparently felt so much better that he failed to return for further treatment.

TABLE II  
SUMMARY OF CASES OF NINETEEN OUT-PATIENTS TREATED WITH SULFANILAMIDE

No.	Race and Sex	Age (Years)	Previous Arthritis	Time Since Last Discharge	Discharge on Initial Visit	Complement-Fixation Reaction	Joint Culture	Duration of Present Arthritis	Joints Involved	Bone Changes	Total Dosage (Grams)	Days Treated	Blood Sulfanilamide (Milligrams per cent.)	Additional Treatment	Degree of Improvement	Remarks
12 Acute Cases																
1	Colored male	23	Yes	2 weeks	Gonococcal	Not done	Not done	1 week	Right knee	No x-ray	44.0	11	?	None	Well	
2	Colored female	18	No	?	Gonococcal	Not done	Positive	2 days	Right wrist and left elbow	Absent	66.0	7	?	Cast and diathermy	Well	Mild anaemia.
3	Colored male	18	No	1 day	Gonococcal	Not done	Not done	1 day	Left hip	No x-ray	51.0	16	?	None	Well	Well 9 months later.
4	Colored female	15	No	?	Gonococcal	Not done	Not done	8 days	Left ankle	No x-ray	21.0	3	?	Cast	Well	Treatment limited by anaemia.
5	Colored female	1¾	No	?	Gonococcal	Not done	Positive	2 days	Metatarsophalangeal	Absent	6.0	8	?	None	Well	
6	Colored female	17	No	?	Non-specific	Not done	Negative	4 days	Left knee and shoulder	No x-ray	54.0	10	?	None	Well	
7	Colored female	15	No	?	None	Positive	Negative	1 day	Left wrist	No x-ray	40.0	9	?	Cast and diathermy	Well	Well 2 months later.
8	Colored female	24	No	?	Gonococcal	Not done	Not done	11 days	Right knee and ankle	Absent	84.0	14	?	Bed rest	Well	Still asymptomatic 2 months later.

TABLE II (Continued)

9	White male	36	No	5 weeks	None	Not done	Not done	2 weeks	Left knee	No x-ray	57.6	19	?	None	Well	
10	Colored male	22	No	6 months	None	Not done	Not done	3 days	Right wrist	Absent	57.8	19	?	Cast	Well	
11	Colored female	14	No	1 year	Non-specific	Positive	Negative	2 weeks	Right knee	Absent	144.0	20	?	Cast, aspiration, and air injection	Well	
12	Colored female	19	No	?	Gonococcal	Positive	Positive	4 days	Left ankle	Absent	67.2	14	?	None	Marked	Treatment continued at home.

## 6 Subacute Cases

13	Colored male	29	No	6 months	Gonococcal	Not done	Not done	3 weeks	Right ankle	No x-ray	84.0	27	?	None	Well	Well 2 months later.
14	Colored male	29	No	2 months	Gonococcal	Not done	Not done	2 months	Left ankle	No x-ray	42.0	9	?	None	Well	Well 2 months later.
15	Colored female	27	Yes	?	Non-specific	Positive	Not done	4 weeks	Right foot	Absent	49.0	7	?	Cast	Well	Severe gastrointestinal symptoms.
16	Colored female	17	No	?	Gonococcal	Not done	Not done	3 weeks	Right wrist	Absent	51.0	15	?	Cast, baling, and massage	Well	Mild anaemia.
17	Colored female	18	No	?	Gonococcal	Positive	Not done	2 months	Left ankle	Absent	30.0	6	?	Strapping	Well	Severe dizziness.
18	Colored male	26	No	2 years	None	Positive	Not done	1 month	Right knee	Absent	54.0	14	7.7	Cast and diathermy	Marked	Slight stiffness persisted.

## 1 Chronic Case

19	Colored male	40	No	7 years	None	Positive	Not done	3 months	Shoulders	No x-ray	50.0	7	?	Prostatic massage	None	Prostatic massage advised.
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TABLE III  
SUMMARY OF CASES OF FIFTY PATIENTS  
TREATED WITH SULFANILAMIDE

Type of Patient	Total No. Cases	Degree of Improvement					Total Acute Cases	Degree of Improvement					Total Subacute Cases	Degree of Improvement					Total Chronic Cases	Degree of Improvement				
		Well	Marked	Moderate	Slight	None		Well	Marked	Moderate	Slight	None		Well	Marked	Moderate	Slight	None		Well	Marked	Moderate	Slight	None
Hospitalized.....	31	16	4	2	2	0	24	16	4	2	2	0	4	0	2	0	1	1	3	0	1	0	1	1
Out-Patient Department..	19	11	1	0	0	0	12	11	1	0	0	0	6	5	1	0	0	0	1	0	0	0	1	
Total.....	50	27	5	2	2	0	36	27	5	2	2	0	10	5	3	0	1	1	4	0	1	0	1	2
Percentages.....		75.0	14.0	5.5	5.5	0.0		50.0	30.0	0.0	10.0	10.0		50.0	30.0	0.0	10.0	10.0		0.0	25.0	0.0	25.0	50.0

Only one patient with a chronic case was treated primarily with sulfanilamide. This individual failed to show any improvement. No roentgenographic examination was made, so bone changes may have accounted for the apparent failure. The patient had a chronic prostatitis, which persisted after the one week of sulfanilamide administration, and another course of prostatic massage was recommended.

Much has been written about the toxicity of sulfanilamide. Allen and Short<sup>1</sup> have summarized the most common toxic manifestations as headache, dizziness, tinnitus, drowsiness, disorientation, and paraesthesia; gastro-intestinal symptoms of nausea, vomiting, and anorexia; skin rashes; febrile reactions independent of the disease under treatment; and blood-stream changes, including cyanosis, alterations in blood chemistry, anaemia, and granulocytopenia. Marshall and his coworkers<sup>10</sup> suggest that the last group should be considered idiosyncrasies rather than toxic reactions.

Many of the patients in this series had mild toxic symptoms, and in twelve some degree of anaemia developed. Three required blood transfusions before leaving the Hospital. It is obvious that the side effects of sulfanilamide are of sufficient frequency that all patients who are receiving the drug should be followed with great care and given periodic blood examinations. Routine hospitalization is recommended.

Of the fifty patients treated with sulfanilamide, 82 per cent. were either cured or markedly improved. The end results in each of the clinical groups have been summarized in Table III. The best results were noted in the acute cases. In this group no complete failures were encountered; 75 per cent. were discharged well, and an additional 14 per cent. were markedly improved.

The results also were encouraging in the subacute group. Of the ten patients, five were cured and three showed marked improvement.

Unfortunately, only four patients with chronic cases were treated with sulfanilamide alone. These responded very poorly to the drug, but this therapy should be tried in a much more representative series of long-standing cases before any definite conclusions can be reached.

The duration of sulfanilamide therapy varied from three days to thirty-three days, with an average of eleven days. Of the patients discharged well, the average duration of treatment was twelve days. The dosage of the drug also showed considerable variation. The total amount administered in the cured cases averaged fifty-four and three-tenths grams or approximately four and five-tenths grams per day.

Blood sulfanilamide determinations were lacking in some instances, especially in those cases treated in the Out-Patient Department. Curiously enough, one patient was cured with a blood sulfanilamide of only two and eight-tenths milligrams per 100 cubic centimeters, while another was only markedly improved, despite a blood sulfanilamide of twenty milligrams per 100 cubic centimeters. These cases are further proof of the marked variations in individual responses to the drug. Everyone

agrees that the blood level, rather than total dosage, should be the index of treatment, and in this series the best results appear to have been obtained in those cases where the blood sulfanilamide reached at least eight milligrams per 100 cubic centimeters.

Supplementary therapeutic measures proved valuable in several instances. Casts or splints were used to relieve the acute subjective symptoms in nineteen cases, and physical therapy was employed in fourteen cases to hasten complete return of function. The rational use of these auxiliary measures will be considered in more detail in our proposed plan for routine treatment of gonorrhoeal arthritis.

A small percentage of poor results is inevitable, due to drug sensitivity and failure of some patients to respond properly to any type of therapeutic measures. Because of these anticipated failures, we feel that any outline of routine therapy must include adequate provisions for the care of these less fortunate individuals. On the basis of the results noted in these fifty cases, the following plan of treatment has been adopted at this institution.

As soon as the patient is seen and the full history, physical examination, and routine blood studies have been completed, urethral or vaginal smears are taken; these are stained by the Gram method and examined for gonococci. In the male, if no urethral discharge is present, the prostatic fluid is examined for evidence of infection. In the female, the gynecologists are consulted about the possibility of salpingitis. In all cases, any demonstrable genito-urinary exudate is cultured for gonococci when possible.

The involved joint or, in the case of polyarthritis, the most acute and easily accessible joint is next aspirated. While preparation for the aspiration is being made, the laboratory is notified in order that the media may be prepared properly and may be ready for immediate transfer of the joint fluid before it becomes cool. A small portion of the joint fluid is saved for smears to identify the organism, if possible, and to estimate the cellular reaction in the fluid to the infection.

After the aspiration, a venipuncture is done for the routine blood Wassermann and gonorrhoeal complement-fixation reactions. On the day of the initial examination, a roentgenogram of the affected joint is taken also to determine the presence or absence of bone changes due to the infection.

These diagnostic procedures should rule out all the joint lesions exclusive of obscure arthritides that simulate gonorrhoeal arthritis in all aspects except the isolation of the gonococcus from the synovial fluid. These cases fortunately are rare, but they may account for some of the poor responses to sulfanilamide therapy.

Chemotherapy is instituted without waiting for the joint-culture report or for the complement-fixation determination. It has been shown conclusively that the best results are obtained with immediate administration of the drug. At the same time the acute joints are immobilized to relieve acute symptoms.



The patient is given one and two-tenths grams (twenty grains) of sulfanilamide with an equal amount of sodium bicarbonate every four hours until a blood level of at least eight milligrams per 100 cubic centimeters has been reached. If the patient is hospitalized (as is recommended), a "special chart" is kept by the nursing staff. If treatment must be conducted in the Out-Patient Department, the patient is watched carefully for any signs of toxicity or of sensitivity to the drug. Daily red and white blood-cell counts, hemoglobin determinations, and quantitative blood sulfanilamide determinations are made in all cases if possible. If sulfanilamide is found to be injurious to the patient, it is discontinued immediately and fluids are given by oral and intravenous routes to eliminate the drug rapidly. These unfortunate patients are then subjected to the other therapeutic measures which will be mentioned later.

If the patient tolerates sulfanilamide properly, and if the correct blood level is reached without difficulty, the dose of the drug and of the sodium bicarbonate is halved. If the blood concentration of sulfanilamide continues to rise during the next twenty-four hours, the dose is reduced to three-tenths of a gram every four hours with an equivalent amount of sodium bicarbonate. This maintenance dose varies with each individual, as does the required maximal dose, and may be increased or reduced according to the blood-level indications. After the optimum blood concentration has been reached, the blood determinations are carried out every forty-eight hours instead of at daily intervals.

During the entire period of treatment the genito-urinary and joint symptoms are followed closely. In most cases the drug is discontinued four days after the complete disappearance of the joint symptoms, providing the primary genito-urinary infection does not persist. (The average duration of treatment in the cured patients of this series was twelve days.) Each patient is followed routinely by a urologist or by a gynecologist. No patient can be considered cured until cultures from the genito-urinary tract are sterile. In a few instances the associated discharge will continue after the arthritic complication has subsided. In many of these cases the discharge will disappear if the sulfanilamide is continued, and in such cases the drug is maintained for at least seven days after the genito-urinary tract is apparently negative. Occasionally recurrences of the urethritis, salpingitis, vaginitis, or arthritis may follow withdrawal of the sulfanilamide. Active chemotherapy should be resumed at once in these cases.

In some cases of gonorrhoea the patients will not respond to sulfanilamide despite large doses of the drug over a long period of time. These patients with resistant infections of the genito-urinary tract are given the conventional forms of local therapy by the attending urologist or gynecologist until cured.

If no bone changes are noted in the roentgenograms, the drug should be continued for from four to six weeks before it is abandoned. However, additional therapeutic measures should not be withheld for so long

a period of time, because of the danger of progressive joint destruction. The following supplementary forms of treatment are employed routinely and should safeguard these resistant cases as well as hasten the recovery in the more responsive patients. According to this series, 18 per cent. of the cases of gonorrhoeal arthritis do not respond well to sulfanilamide.

Immobilization of the affected joints during the acute stage of the disease, as recommended by Bennett<sup>3</sup>, is used if the subjective joint symptoms warrant it. A splint, skin traction, or a bivalve cast may be used, but should be constructed so that the joint may be inspected daily. The joint is immobilized only during the phase of acute, distressing symptoms.

If, after from four to eight days, the joint does not respond satisfactorily to the sulfanilamide therapy, air injection of the joint is combined with the chemotherapy. Bohlman<sup>4</sup> has described the technique of this procedure in great detail and has shown that it protects the joint surfaces, relieves acute distress, and hastens recovery in many cases, if carried out properly.

Additional measures which have been shown to be of considerable value in gonococcal infections, especially in the chronic types, are intravenous injection of mercurochrome and hyperpyrexia. Young, Colston, and Hill<sup>12</sup> have outlined the most efficacious plan for the administration of mercurochrome. Culp<sup>7</sup> has reviewed twenty-nine cases of gonorrhoeal arthritis treated with intravenous injections of 1-per-cent. mercurochrome and found that in 69 per cent. the patients were cured or markedly improved. The results in the chronic cases paralleled those in the acute and subacute cases. While intravenous mercurochrome is often rapidly effective, sulfanilamide therapy is simpler. When the latter is not tolerated, mercurochrome may be employed with great benefit. Hench<sup>8</sup> tabulated the results with hyperpyrexia in 143 acute and chronic cases and noted 72 per cent. cures.

About one week after the acute joint signs and symptoms have disappeared, physical therapy in the form of baking, massage, diathermy, gentle active and, later, passive motion is added, if necessary, to enhance the *complete* return of function to the joint.

The roentgenographic examination is repeated at the end of the course of treatment, and all patients are instructed to return two months after discharge for a check-up examination. The primary objective in any therapeutic program should be complete restoration of normal joint function.

#### SUMMARY

In gonorrhoeal arthritis, sulfanilamide promises to be the most efficacious form of therapy, but in another paper<sup>7</sup> we have shown that intravenous mercurochrome also may be of great value.

A group of fifty patients, treated with sulfanilamide on the Hospital wards and in the Out-Patient Department, have been analyzed, and 82 per cent. have been found to be cured or markedly improved.

The best results have been obtained in the acute cases and in those instances where the blood sulfanilamide has reached at least eight milligrams per 100 cubic centimeters.

A practical plan for routine treatment of all cases has been proposed, including minor forms of supplementary therapy which will be especially valuable in the small number of cases in which the response to chemotherapy alone is unavoidably poor.

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# DISLOCATION OF THE LESSER MULTANGULAR

## REPORT OF A CASE

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Mr. K., a machinist, was struck by an automobile on December 5, 1935. He suffered severe pain in the right wrist, but roentgenographic examination at a local hospital revealed no fracture or evidence of dislocation. The patient refused to stay in the hospital and was treated at home. On January 4, 1936, he was referred to the author, because of pain and inability to use the wrist.

At that time examination of the wrist showed the following: The hand was held in slight palmar flexion and was very swollen. On palpation of the proximal row of bones no abnormality was noted except a certain amount of swelling in the wrist. Palpation over the distal row gave a feeling of considerable thickening at the bases of the first, second, and third metacarpals. Tenderness was marked over the base of the first metacarpal and in the region of the navicular. Tenderness was also noted in the anatomical snuffbox. Motion in the injured wrist was present as follows: extension of 35 degrees, all of which seemed to be in the proximal row; flexion of about 25 degrees; ulnar deviation of 25 degrees; no radial deviation. In closing the hand all motions of flexion were limited. There was a lack of ability to open and to close the fingers, the attempt being accompanied by pain in the wrist. When forceful pressure was applied to the distal row of carpal bones, pain was especially noted in the index and second fingers.

After several roentgenographic examinations had been made, the following report was submitted on January 10, 1936: "Stereoscopic anteroposterior and special oblique films were made of both wrists for comparison. These films show the dislocation of the lesser multangular. In the stereoscopic films the lateral edge of this bone appears to be displaced backward and proximally over the back of the navicular. The greater multangular has been displaced somewhat forward and inward into the space left vacant by the partial backward luxation of the lesser multangular. There is some roughening of the edge of the greater multangular, and there is a very small loose chip just back of the carpus." The patient's hand was put in a plaster cast in a slight cock-up position during this period of roentgenographic examination. He had considerably more comfort following the application of the cast.

The patient was sent to the hospital on January 22, 1936, where an operation for the removal of the lesser multangular was performed through a two-inch incision over the base of the second metacarpal on the back of the hand extending upward on the wrist. The soft tissues were retracted, and the dorsal carpal ligament was cut sufficiently to allow exposure. The position of the lesser multangular was identified by the tendon of the extensor carpi radialis longus, which is inserted into the base of the second metacarpal and which should lie just distal to the position of the lesser multangular. This tendon was found to be stretched and firmly attached, and there seemed to be a tendency for the tendon to pass over a bony prominence. The abductor pollicis longus and the extensor pollicis brevis were retracted to the radial side, and the extensor carpi radialis longus was retracted to the ulnar side. The bone was found to be in three fragments, which lay in a horizontal position as compared to the normal perpendicular position. The bone was dissected out of the wrist and removed in three pieces. As soon as this was accomplished, all of the motions of the wrist, which previous to this time had been limited, were very much freer, so that a nearly normal range could be obtained. The soft tissues were allowed to fall into place, and the dorsal carpal ligaments were sutured. The soft tissues closed without drainage, and a plaster cast was applied with the hand in a cock-up position.



FIG. 2

Postoperative roentgenogram showing how the greater multangular has moved into the position of the lesser multangular. May 18, 1936.

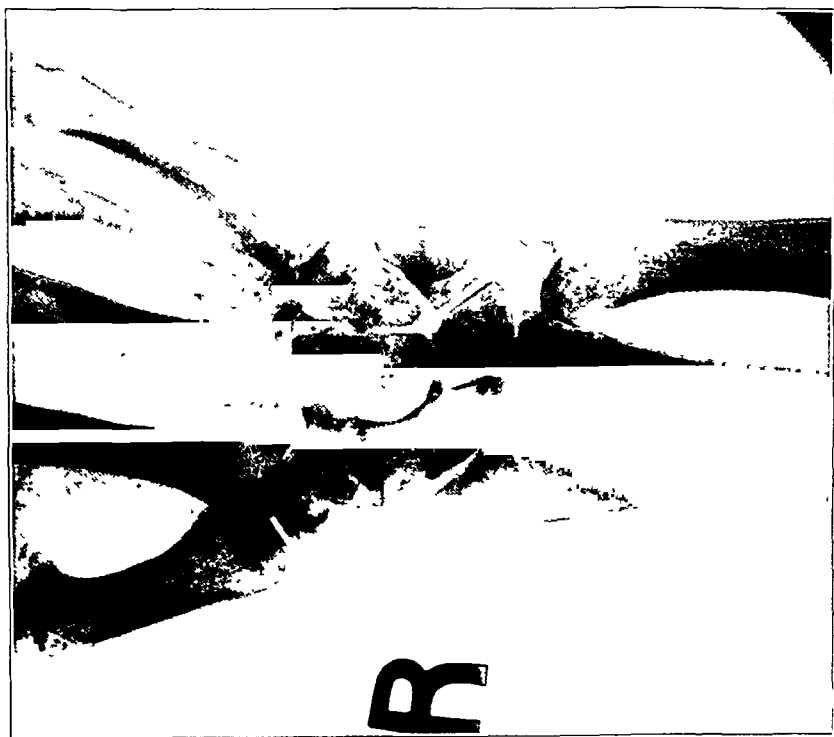


FIG. 1

Preoperative roentgenogram showing displaced lesser multangular. January 8, 1936.

The patient left the hospital on the seventh day, feeling much improved and having more motion in his fingers than he had had prior to the operation. The sutures were removed on the tenth day; the cast, in three weeks. At the time of the removal of the cast, motions of the fingers were practically normal and painless. There was much improvement in flexion and also in extension of the wrist. Ulnar deviation of the wrist was normal, but radial deviation was 50 per cent. of normal.

The patient at present is employed as a painter. He has normal extension, flexion, and ulnar deviation, as well as 75 per cent. of normal radial deviation.

There is a natural tendency for the lesser multangular to dislocate to the posterior side, because the posterior surface of this bone is larger than the anterior surface. Roentgenograms in July 1939 revealed that the greater multangular had, to a great extent, invaded the position of the lesser multangular, which had resulted in some weakness of the thumb.

## SYPHILITIC OSTEOMYELITIS

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Syphilis of the bone may be congenital, but it is more often a disease of adults between the ages of twenty and forty. It is a secondary or tertiary phenomenon and is seldom seen before two years following the infection, although syphilitic periostitis has been described as occurring synchronously with the primary sore or from two to fifteen weeks afterward. It usually affects the shafts of the long bones or the outer table of the skull. In the majority of the cases the predominant changes are periosteal, and there is bone hyperostosis. Roentgenographically, the affected bone shows marked periosteal changes; it assumes a characteristic spindle shape, and the outline of the medulla becomes obliterated. In old cases, gumma, in the form of localized lesions, may be seen, or small sequestra may even form. In fact, when syphilis invades bone, the resulting roentgenographic appearance may simulate that of any bone lesion, and the diagnosis is doubtful until a biopsy is done.

Gummatous osteomyelitis in adults leads to an extensive change in bone dependent upon bone destruction and new-bone formation, in which destruction generally predominates, and produces very irregular areas with mottling. The following case report supports this.

A. L., male, aged forty-three years, colored, was admitted to the U. S. Marine Hospital on October 1, 1937, complaining of pain in the legs. He denied having had penile lesions and stated that he had been in good health prior to his present illness, which had begun in 1931. At that time his neck had become stiff and painful, and there had been a cracking sensation on motion. The condition had become gradually worse, the neck being absolutely stiff at the time of admission. In 1932 he had noticed similar symptoms in the left arm, but these did not progress. Three years later he had noticed several hard lumps on the outer surface of the sternum; these grew and receded alternately, occasionally becoming painful and tender. The patient had lost twenty pounds in the past year. He had never been treated for syphilis.



FIG. 1

The skull shows extensive osteoperiosteal changes with marked bone sclerosis intermingled with bone rarefaction of the upper vertebrae. There is thickening of the exterior table of the posterior portion of the dome. The sternum also shows similar changes.

Physical examination on admission revealed stiffness of the neck, bone tumors of the sternum, and marked roughness of the bone at the crest of the ilium. An old penile scar, shotty epitrochlear, posterior cervical, and inguinal glands, and marked limitation of motion of the spine were also noted.

Laboratory findings were as follows:

Red blood cells—3,000,000

Hemoglobin—52

White blood cells—7,400

Lymphocytes—32 per cent.

Monocytes—6 per cent.

Eosinophiles—4 per cent.

Neutrophiles—58 per cent.

Blood calcium—11 milligrams per 100 cubic centimeters

Blood phosphorus—3 milligrams per 100 cubic centimeters.

The blood Wassermann reaction was strongly positive, and the Kahn test was 4 plus. The spinal Wassermann reaction was negative. There was a trace of globulin, and the cell count was 2. Urinalysis showed a moderate amount of pus cells.

The diagnosis of syphilitic osteomyelitis was made on the roentgenographic findings (Figs. 1, 2, 3, and 4) and confirmed by biopsy on October 13, 1937. The pathological report on the section of bone removed from the sternum (Fig. 5) was as follows: "The material submitted consisted of bone. The cancelli showed irregular erosion, rarefaction, and necrosis. Some showed hyperostosis and sclerosis. An occasional newly formed spicule was found. The marrow spaces were filled with fibrosing and fibroblastic granulation tissue, which presented a granulomatous appearance. It was densely infiltrated by plasma cells and fewer lymphocytes. In some marrow spaces the granulation tissue showed beginning or advanced caseous necrosis. In areas the entire tissue was represented by caseous amorphous material. An occasional spirochete morphologically compatible with *treponema pallidum* was demonstrated."

The patient received antiluetic therapy, consisting in the administration of arsenamine bismuth and potassium iodide. On December 16, 1937, he was transferred

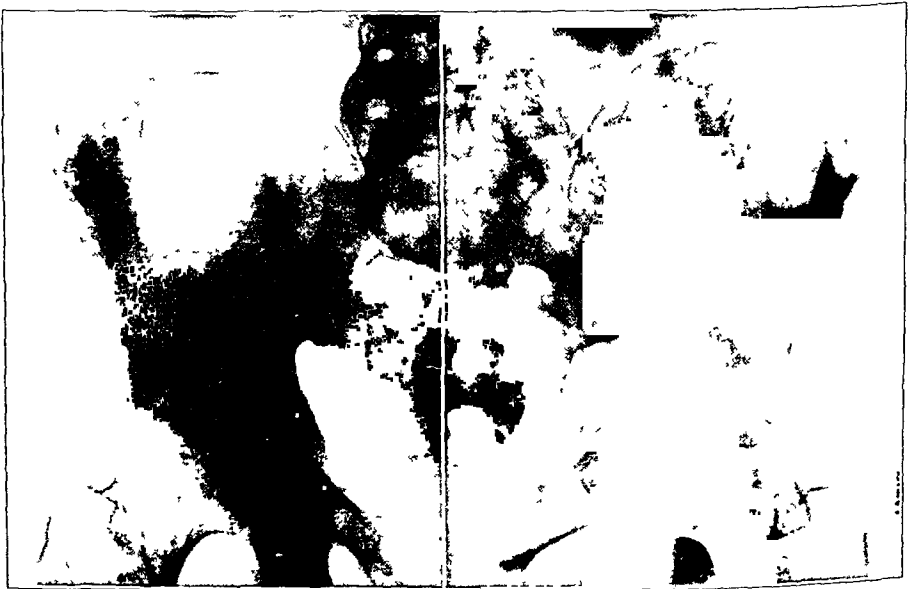


FIG. 2

Marked osteoperiosteal changes are seen in the iliac portions of the innominate bones. Extensive sclerosis and rarefaction are present.



to a Veterans' Hospital for further antiluetic treatment. When last seen on January 29, 1938, he had no pain, was able to move the head through an arc of about 70 degrees, and could also flex the back to some degree, which showed marked improvement.



FIG. 3

There is more or less diffused sclerosis of the right clavicle. The sixth rib on each side shows expansion of the bone at its vertebral extremity. The first rib on the right shows bone sclerosis.

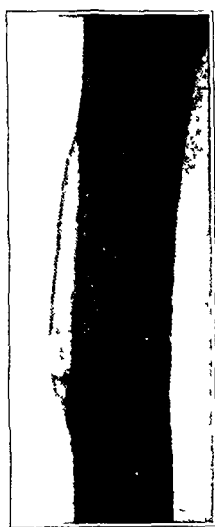


FIG. 4

A localized area of marked periosteal changes is present in the upper half of the right femur.

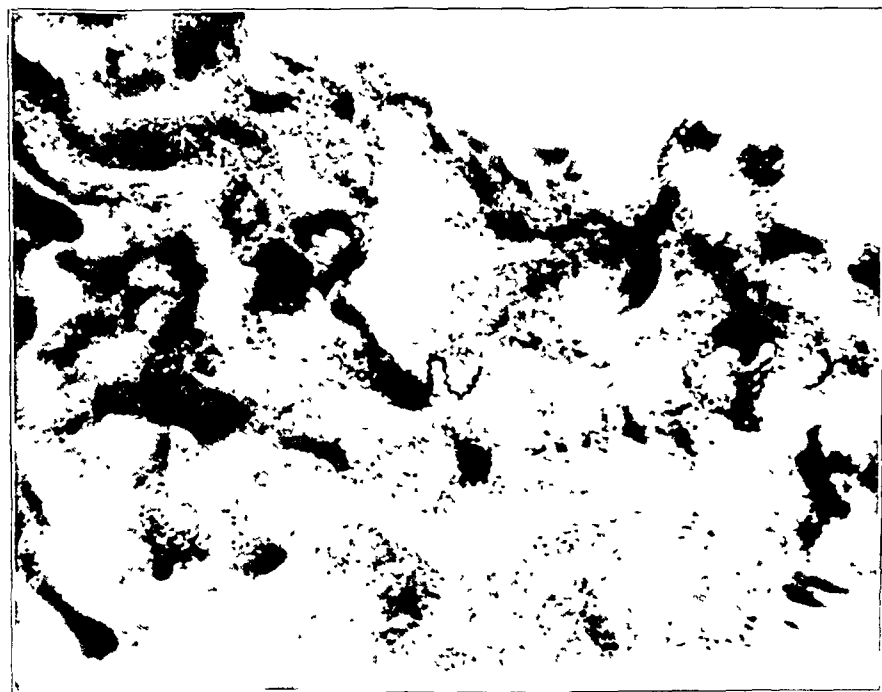


FIG. 5

Photomicrograph of bone taken from sternum showing the presence of spirochetes.

In this case the roentgenographic diagnosis of syphilis was based not on any one typical finding, but on the diversity and widespread distribution of the lesions. This diagnosis was confirmed by biopsy.

In the treatment of patients with osseous lesions, the first injection of arsphenamine is often followed by an intense exacerbation of pain, which lasts from twelve to twenty-four hours. In most instances this exacerbation is in turn followed by prompt relief from pain, and the patient is symptom-free, perhaps for the first time in months. This is the usual course of events when the lesion is periosteal only; if the whole bony structure is involved, disappearance of symptoms may be much more gradual, requiring days or even weeks. Little or no objective change takes place in the osseous lesions; deformity is usually due to the deposition of new bone, which treatment will not remove. The objectives of treatment are, then, the healing of the lesions, the avoidance of progression of the disease or relapse, and the prolongation of life. If these aims are accomplished, the clinical outcome of treatment may justly be considered as satisfactory.

As in all other types of syphilitic infection, the patient should be kept under observation indefinitely. Repeated physical surveys, with special emphasis on examination of the heart and aorta, should be carried out as long as the patient lives.

# TUBERCULOSIS OF THE FLAT BONES OF THE VAULT OF THE SKULL

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Tuberculosis of the bones is a common condition, but tuberculosis of the flat bones, particularly those of the skull, is, though an uncommon condition, by no means a rare one.<sup>2</sup> The flat bones of the vault of the skull comprise about 1 per cent. of all bone tuberculosis. Less than 250 cases have been reported in the literature, and 50 per cent. of all the cases reported have occurred in children under the age of ten. Seventy-five per cent. of the cases have occurred in patients under twenty years of age. The incidence decreases as age increases.

Males are probably more commonly affected, because of trauma which is believed to be an etiological factor. There is rarely a manifestation of a serious general tuberculosis, although it is almost always secondary to other lesions. The lungs, the lymphatics, and bones other than the flat bones are the common foci. The posterior cervical lymph glands are most frequently the primary focus, the tonsils being the portal of entry. Infection is usually blood borne from distant foci, and the initial localization is in the cancellous bone of the diploe. The frontal and parietal bones are most commonly affected. Since the flat bones of the vault of the skull contain only a small amount of cancellous bone, the explanation for the rarity of such lesions is apparent. In the majority of cases the process extends first to the inner table of the skull, then to the outer table, and finally perforation occurs, with or without sequestration, depending upon the rapidity of bone destruction. A cold abscess forms at the site of the perforation, and the soft parts, which become elevated by pressure, may rupture spontaneously. Subsequent fistula formation occurs. These lesions may be single or multiple, but they are always a part of the whole disease process. Single perforations are more common. The initial symptoms of this condition are usually vague. Generally, however, localized tenderness and headache are present, followed by swelling of the soft tissues. For this reason, diagnosis is not made until perforation has occurred. Roentgenograms reveal the presence of a punched-out defect, definitely circumscribed by normal bone.<sup>4</sup> This finding is characteristic. Search should be made for the primary focus. It has been noted that the diaphyses of the long bones not infrequently show an associated tuberculous involvement.<sup>1</sup> Additional information

may be gained from guinea-pig inoculation with material from the abscess, from direct smears, and from tuberculin tests.

In the differential diagnosis such conditions as gumma, acute or chronic osteomyelitis, osteosarcoma, cephalohematoma, hydatid cyst, and other tumors are to be considered. The prognosis depends on the extent of the tuberculosis elsewhere in the body and upon the type of bone lesion present. The prognosis is good if the lesion is circumscribed and if the general condition of the patient is good. The proper treatment is prompt radical surgery with removal of all diseased tissues.

Essential features of tuberculosis of the flat bones of the vault of the skull have been summarized from the work of Straus,<sup>3</sup> who, in 1933, completely reviewed the literature and presented three cases of his own.

We wish to report a case which presents some of the characteristics of this condition.

#### REPORT OF CASE

D. A. G., a soldier, thirty-six years of age, was admitted to the Letterman General Hospital, on August 29, 1939. He had been entirely well until seven weeks prior to admission, when he had begun to have sharp, intermittent, left temporal headaches, which originated in the left supra-orbital region and radiated backward to the left temporo-parietal region. The pain was of short duration, but it was extremely severe while it lasted. Such headaches continued for about a month before the patient noticed an area of localized tenderness over the vertex of the skull, located in the parietal region, slightly to the left of the mid-line. A small mass then appeared. As this mass became larger, local pain and headache over the left side of the head increased. On August 26, 1939, or three days prior to admission, the patient consulted a doctor, who incised the scalp over this mass and evacuated some thin purulent material. This procedure relieved the headache, but localized tenderness about the wound persisted. There was no history of trauma prior to this illness.

The family history was essentially negative. The patient's past history revealed that three years prior to admission he had had an abscess in the soft tissues over the proximal end of the left fibula and a similar one over the proximal end of the right tibia; both of these abscesses had been incised. Each had appeared spontaneously without previous trauma, and each had healed about two weeks after incision. The patient had had measles and mumps in childhood and influenza at fifteen years of age, and had recovered from these diseases without complications. The tonsils had been removed in 1935, because of frequent sore throat during the preceding year. The patient's general health had always been excellent. There was no history of loss of weight, cough, sputum, night sweats, or pleurisy.

Physical examination revealed a well-developed and well-nourished white male, apparently in excellent health. His weight was 160 pounds and his height, seventy-one inches. The temperature on admission was 99.4 degrees Fahrenheit; the pulse rate, 84; and the blood pressure, 120/75. There was an incised wound of the scalp, four centimeters in length, running parallel to and two centimeters from the mid-sagittal line in the parietal region. There was a moderate amount of purulent drainage from this wound. By retraction of the wound, the skull could be satisfactorily examined under direct vision. A round circumscribed defect, one centimeter in diameter, was seen in the left parietal bone slightly to the left of the mid-line. The posterior cervical glands were somewhat enlarged, discrete, and non-tender. The tonsils were missing. Two irregular scars were seen over the proximal ends of the lower legs: one located over the head of the left fibula; the other, over the anterior surface of the right tibia. These scars were non-adherent, and there was no palpable associated bone defect.

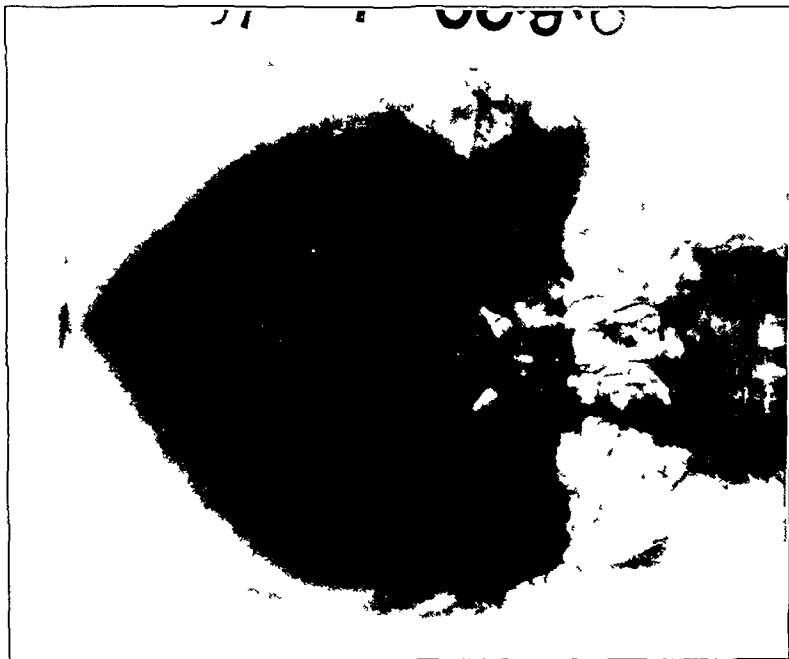


FIG. 2

Anteroposterior view, showing loss of continuity of cranial cortex.



FIG. 1

Roentgenogram showing bone defect in parietal area, suggestive of drill hole through both tables, without bone reaction.

The differential blood analysis was as follows:

Red blood cells—	5,210,000
Hemoglobin—	85 (Dare)
White blood cells—	6,750
Polymorphonuclear neutrophiles—	68 per cent.
Lymphocytes—	28 per cent.
Monocytes—	2 per cent.
Eosinophiles—	2 per cent.

The urine was normal. Blood serology (Kahn and Wassermann) was negative. The sedimentation rate was thirty-five millimeters in one hour. Repeated smears made from the scalp wound showed many acid-fast bacilli. The Mantoux test was strongly positive.

Roentgenograms of the skull revealed a sharply defined defect in the left parietal bone slightly to the left of the mid-sagittal suture. This defect was one centimeter in diameter, and its margins showed bone of normal appearance. Roentgenographic studies of the lungs and of the upper tibiae and fibulae were negative.

A diagnosis of tuberculosis of the left parietal bone was made. The clinical course while in the Hospital was uneventful. The discharge from the scalp wound lessened considerably; granulation tissue appeared and extended outward from the bone defect, undermining the scalp. Pulsations synchronous with the pulse were noted in the defect in the parietal bone. The temperature ran an irregular course, but never exceeded 99.4 degrees Fahrenheit. The pulse rate remained within normal limits. The posterior cervical lymph nodes diminished in size considerably, and, at the time of the patient's transfer from this Hospital, they were barely palpable. The scalp wound was dressed daily, and an effort was made to keep this wound clean as a preparation for surgical removal of diseased tissues, which will probably be carried out at a later date.

Under existing Army Regulations, all military patients with any form of tuberculosis are hospitalized in Fitzsimons General Hospital, Denver, Colorado. This patient was transferred to that Hospital for further observation and treatment on September 23, 1939.

Prognosis in this case should be good, since this is apparently a solitary lesion and the health of the patient is excellent.

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# AN ADHESIVE STRAPPING FOR SPRAIN OF THE ANKLE\*

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Although commonly considered a minor injury, sprain of the ankle looms as a very definite problem which confronts the average physician. The disability engendered by this injury is the source of very considerable economic loss to patients, when the frequency of the injury is considered.

The ankle is an extremely vulnerable joint, partly on account of its anatomical construction and partly because of the additional insecurity imposed upon it by poorly designed footwear. Although properly speaking the ankle joint comprises solely the articulation between the tibio-fibular mortise and the talus, from a practical standpoint, it must be considered to include the train of joints which are interposed between the leg and the foot; and, from the standpoint of the average sprain, the joints lying below and anterior to the talus are most involved in the mechanism through which the so-called ankle is wrenched. The ankle joint proper is concerned almost entirely with the motions of dorsiflexion and plantar flexion, which are not commonly involved in the average sprain. The motions of adduction-supination and, less often, of abduction-pronation are involved in the production of this injury. These are primarily motions taking place in the subtalar articulations and, therefore, they involve the calcaneum. It can be roughly stated that as the calcaneum goes, so goes the foot.

The mechanism of the average sprain is rotation of the calcaneum, due to a misstep or to unexpected unevenness of terrain, either in the direction of supination or of pronation to such an extent that the thrust of the body weight falls upon the lateral ligaments of the ankle joint,—that is, either the calcaneofibular ligament in the case of supination of the heel or the calcaneotibial ligament in the case of pronation of the heel. The sprain itself is caused by stretching or tearing these ligaments. It is, therefore, imperative in treating a sprain that the stabilization of the calcaneum in such a position as to relieve ligaments which have been overstrained or torn from any possible stress be considered as the prime indication. The immobilization of the calcaneum against lateral movements is necessarily an important factor in the treatment of sprain. It is not essential that the calcaneum be fixed in complete pronation or in complete supination in the case of inversion sprain or of eversion sprain, respectively. However, if treatment is to be ambulatory and relatively painless, it is essential that the position of the calcaneum be fixed in such a manner as to avoid any stress upon the injured ligamentous structures.

\*From the Orthopaedic Services of Charles H. Jaeger, M.D., Lenox Hill Hospital, and Isadore Zadok, M.D., Hospital for Joint Diseases.

The boot strapping introduced by Dr. Virgil P. Gibney has long been an almost universally accepted standard dressing for the ambulatory treatment of these injuries, and the strapping herein described was developed as a means of increasing the effectiveness of the Gibney strapping in controlling lateral motions of the calcaneum.

This system of strapping, which has been used over a period of twelve years or more, aims to lock the calcaneum in a fixed position, which can be determined by the operator according to the necessities of the case. In an ankle which has been subjected to an inversion (supination) sprain, the calcaneum can be fixed in any degree of eversion (pronation), or in the rare double sprain, in which the ankle executes excessive motions in both directions, the calcaneum can be locked by this strapping in mid-position. So held, the ligaments which have been injured are spared from active strain, and function of the foot is possible almost immediately.

#### APPLICATION OF STRAPPING

The hair should be shaved from the foot and from the lower third of the leg. A pad of thin felt or flannel, somewhat wider than the tendo achillis and about four inches long, is cut and glued with some type of skin varnish to the skin posteriorly over the tendo achillis. The skin of the foot and lower third of the leg is painted with tincture of benzoin in order to diminish the possible adhesive dermatitis. Two lengths of one-inch adhesive strapping are then cut. The greater of the two lengths is measured from the outer aspect of the leg about eight inches above the malleolus, around the plantar aspect of the heel, to a point on the leg eight

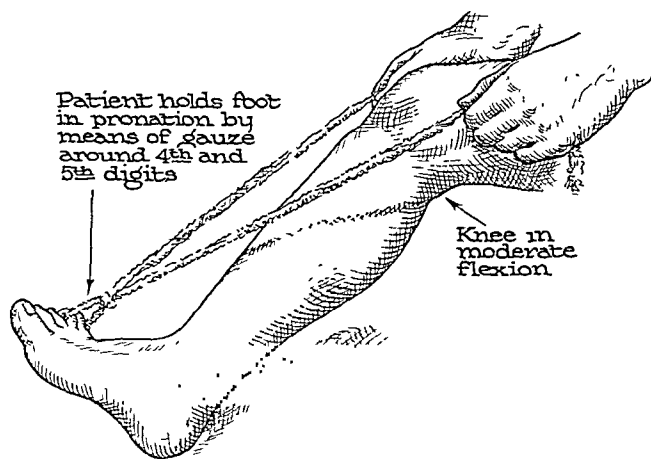


FIG. 1

Sketch illustrating the method of maintaining the desired position of the foot in relation to the leg for applying the strapping. The flexion is essential in order to relax the gastrocnemius group of muscles, thus permitting the foot to come into a right-angle position with the leg. In this illustration the gauze loop is applied in a manner which will produce a moderate degree of pronation. If a position of supination is desired, the loop should be placed around the great and second toes.

inches above the medial malleolus. Approximately eight such lengths are necessary for an average strapping. The shorter straps are measured from the distal third of the fifth metatarsal bone on the outer aspect of the foot, around the heel, and then obliquely under the sole of the foot to the starting point. Approximately fifteen such straps are necessary. The patient sits with the knee flexed to a right angle in order to relax the



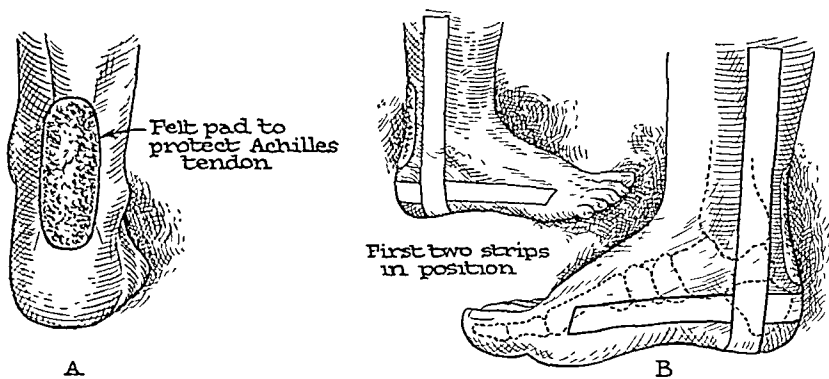


FIG. 2

*A:* In order to prevent the chafing of the heel by the adhesive strapping, it is desirable to glue a thin strip of felt or of heavy flannel over the tendo achillis. Some type of non-irritating skin varnish or liquid adhesive is used to fasten this strip in position.

*B:* The relation of the two initial straps to the bones of the foot is illustrated.

tendo achillis, and he holds the foot in the position elected by the operator with the assistance of a gauze bandage looped around the toes in such a manner as to exert traction in the desired direction (Fig. 1).

The two initial straps of the dressing are laid on in precisely the manner used in the Gibney boot,—that is, the first strap (a long strap) extends around the heel from the lower third of the leg parallel to the course of the fibula and sufficiently posterior to pass over or somewhat behind the lateral malleolus. The second strap (a short strap) extends from the distal third of the fifth metatarsal bone to the distal third of the first metatarsal bone, thus crossing the first strap at right angles (Fig. 2, *B*). The straps are put on with the major tension in the direction in which fixation of the calcaneum is desired. The next step is the application of a series of straps, which constitutes the important phase of the dressing. Three sets of three straps each are interlocked, so as to control effectively any lateral motion of the calcaneum. The first of these straps is a long longitudinal one. This strap is laid upon the leg with a forward inclination of 10 degrees from the first longitudinal strap already applied, and overlaps this strap about one-half its width as it rounds the foot. If the successive longitudinal straps are also applied with this inclination from the immediately preceding strap, it will be found that each adhesive strap will pass around the foot and up the opposite side of the leg with the same 10-degree inclination from the preceding strap (Fig. 3, *A*).

Following the placing of the longitudinal strap just described, a pair of the shorter straps is applied in an interlocking fashion, so as to incorporate the heel in a system of straps, which will effectively immobilize it against any lateral or medial motion. The first strap is applied overlapping the preceding transverse strap by one-half of its width. The side of the foot from which this strap is started will depend upon whether the operator wishes to pull the foot into pronation or into supination. The strap is started parallel to the preceding strap, but, when it is brought

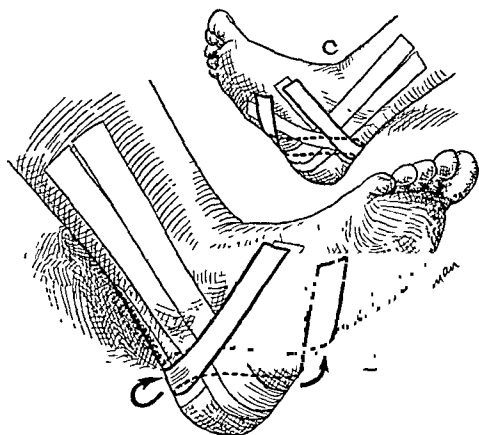
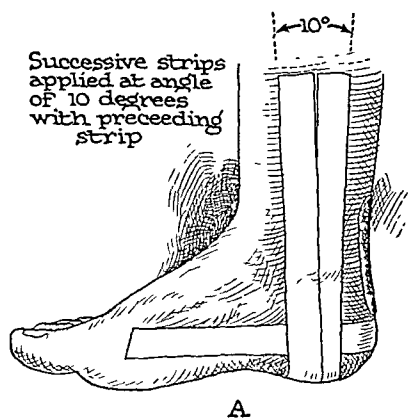


FIG. 3

A: The forward inclination of the successive longitudinal straps is illustrated. This inclination is necessary in order to have the straps conform naturally to the contour of the foot without wrinkling.

B and C: The interlocking of the first pair of horizontal straps is illustrated. The dotted lines indicate the location of the strap as it rounds the opposite side of the foot. It is the interlocking of these straps which produces the immobilization of the subastragalar articulations.

around the heel, instead of being continued directly forward toward the toes, it is carried obliquely downward to the plantar aspect of the foot, and terminated on the sole of the foot a short distance from the point at which it was started (Fig. 3, B). A second short strap is then applied in a similar manner, beginning, however, on the side opposite to that on which the first strap of this pair was started. This strap will cross the heel directly over the preceding strap, and, if continued obliquely over the sole of the foot, will interlock with the preceding strap. It is this interlocking of the straps which confines the heel in such a manner as to prevent lateral motion.

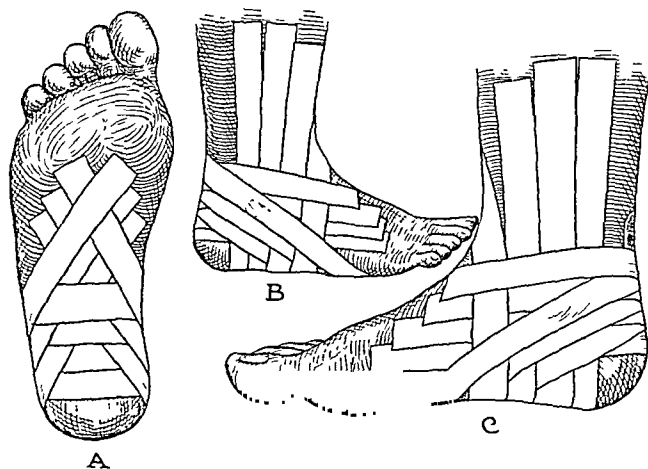


FIG. 4

The strapping as it appears after the application of the three successive pairs of interlocking straps. It will be noted that the straps interlock on all three aspects of the foot, a feature which gives the dressing its stability.

A succession of straps—one longitudinal strap followed by two interlocking transverse straps—are thus applied in rotation, until the heel is completely confined. Usually a series of three such sets of straps are necessary to fix the heel effectively, but occasionally on a large foot a greater number will be required. The appearance at this stage is shown in Figure 4, A, B, and C.

The dressing is completed by applying a series of straps which surround the forefoot and the lower third of the leg. The transverse straps no longer pass obliquely around the heel, but are brought directly around the ankle and the lower third of the leg, as illustrated in Figure 5, A. It will be of some service in applying these straps with uniformity to note that as the bulge of the calf increases, the strap should be placed upon the skin with a downward inclination, this inclination becoming greater with the increase in the bulge of the calf. By doing this, it will be possible to place an encircling strap around the leg, so that its ends are in accurate contact, thus contributing to the smoothness of the dressing. The completed strapping is illustrated in Figure 5, B, C, and D. In order to secure

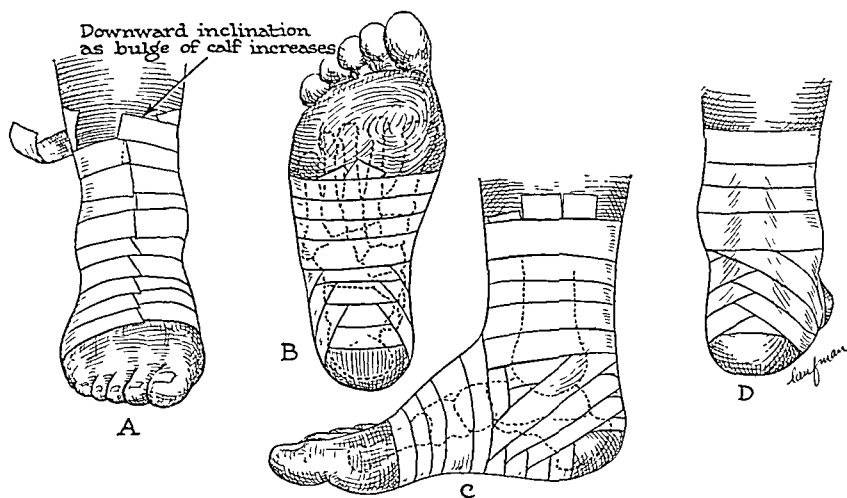


FIG. 5

A: The manner of completing the strapping is illustrated. In order that the circular strappings should begin and terminate at the same level, the downward inclination which is indicated by the arrow must be employed. This inclination should increase as the bulge of the calf increases.

B, C, and D: The finished strapping as seen from the plantar, medial, and posterior aspects of the foot.

a uniform cohesion of the dressing, it is desirable to cover the strapping with a well-applied gauze bandage.

It will be noted that the strapping completely encircles the foot, which will probably give rise to considerable doubt among the readers as to whether this is a safe dressing from the standpoint of circulatory compression. It can be stated, however, on the basis of long experience with this dressing, that, provided the straps are applied with uniform tension and in such a manner as to avoid wrinkling, the dressing is safe even when used upon a freshly sprained ankle.

# A SIMPLE BRACE FOR THE TREATMENT OF PIGEON-TOE IN CHILDREN

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The treatment of pigeon-toe is beset with difficulties which often cannot be overcome by conservative methods of correction. The principle underlying these methods aims at forced toeing-out and fails to take into consideration the various major abnormalities responsible for the deformity. The etiology of pigeon-toe—whether the deformity is the result of metatarsus varus, of torsion of the tibia, or of other underlying factors—requires no detailed consideration. It will suffice to recall that these deformities are frequently associated with a pronation of the heel. The treatment in these instances must, therefore, tend to overcome two opposite forces,—pronation of the heel and supination or simple toeing-in of the forefoot.

A simple brace, embodying some of the principles of an arch support, is employed by the author in cases of pigeon-toe associated with pronation of the heel. The brace will correct the abnormal attitude of the forefoot, adduct the heel, and correct the gait. Experience with this brace is based on ten severe cases. A larger series with lesser degrees of deformity, which might have responded to other methods of treatment, are not taken into consideration.

## CONSTRUCTION OF BRACE

A plaster mold or imprint of the foot is made. The length of the brace is equal to the distance measured from immediately below a line drawn across the level of the metatarsophalangeal joints to another line parallel to the posterior aspect of the heel. The width of the plate is equal to the width of the sole of the foot.

The material used is a fourteen-gauge aluminum. The pattern of the brace is similar to an arch support with a low side flange. The inner aspect of the support is so constructed that the maximum point of elevation—that is, the apex of the longitudinal arch (Fig. 1)—measures one-half of an inch or less. This elevation tapers forward and backward, approaching zero at the forward end of the support, and amounting to three-sixteenths of an inch at the anterior level of the heel. The outer aspect of the support is also elevated. The apex (*b*) of this curve measures three-quarters of an inch and lies immediately behind the metatarsal elevation. The curve tapers forward from the apex, approaching zero at the forward end of the support, and sharply backward, becoming five-sixteenths of an inch at *d*, a distance equal to that from the apex to the

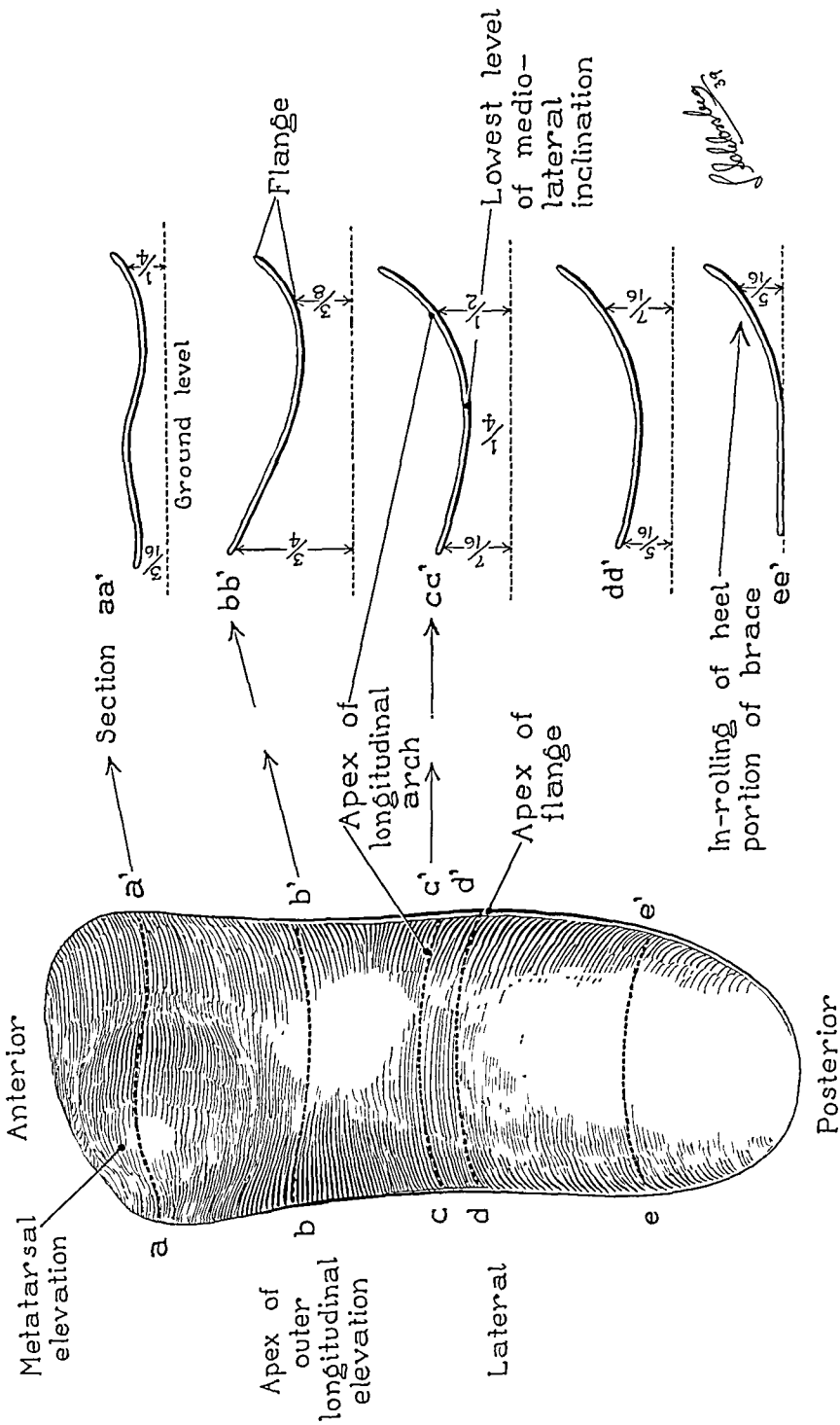


FIG. 1

Pigeon-toe brace: *a-a'*, level of metatarsal apex; *b*, apex and *b-b'*, level of apex of outer longitudinal elevation; *c'*, apex and *c-c'*, level of apex of inner longitudinal elevation; *d-d'*, level of posterior point *d*; *e-e'*, level of anterior border of heel.

anterior border of the outer longitudinal elevation. It becomes zero at the forward end of the heel. The anterior elevation (Fig. 1) is limited to the fourth and fifth toes. The completed brace is covered with thin leather, so as to avoid pressure.

#### DISCUSSION

The foot must be properly fitted with a moccasin type of shoe, which conforms to the shape of the corrected foot more readily than do other types of shoes. A small metal cleat is applied to the heel of each shoe at the point of greatest pressure, since the corrections cause a rapid wearing down of the shoe heels.

The child can usually tolerate an outer elevation of three-quarters of an inch. The brace is worn for one hour the first day, and its use is increased one hour daily, so as to avoid a sudden severe correction. An immediate complete correction of gait is obtained in most instances with an elevation of three-quarters or thirteen-sixteenths of an inch. In very severe cases of pigeon-toe the immediate correction will be incomplete, but the foot should show at least 80 per cent. improvement. Failure to obtain this amount of improvement is an indication of improperly constructed braces. The length of time required to bring about a permanent correction varies from one to several years, depending upon the severity of the case. New braces should be fitted at nine-month intervals. Over-correction of the deformity is desirable and will follow after a variable period of time.

In addition to overcoming the toeing-in, the brace is an adjunct in correcting the associated deformities. It has many advantages over other methods of treating pigeon-toe. Club-foot or reversed shoes in cases of metatarsus varus are not necessary when the braces are employed.

# THE ARTIFICIAL LANDMARK IN BONE SURGERY

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The use of markers on the body as guides in the taking of roentgenograms and in surgery has been common for many years. Skin clips and other metal markers, as well as iodine or dyes, have been employed, but no particular technique has been generally accepted as standard.

The method herewith described has been found very satisfactory over a period of many years. It is particularly valuable in the preparation of patients for open reduction of fractures; it is also used routinely in connection with cases of bone cysts, localized osteomyelitis, etc.

A strong alcoholic solution of brilliant green \* in a bottle having a wire applicator, with a small cotton swab on its lower end and its upper end inserted in the under side of the cork, and a few flattened BB shots are all the equipment required. The skin over the area to be identified at operation is marked by a dot of the dye. Immediately over the spot a flattened shot is placed and held in position by a small piece of adhesive plaster. True lateral and anteroposterior roentgenograms are then taken.

Since the spot of dye is not washed away by the skin preparation, it serves, at operation, as the identifying skin mark corresponding to the shadow of the shot on the roentgenogram. Even when the site of operation is closely draped, it is possible, by a relatively small incision, to expose the point on the bone to be attacked.

\* The use of brilliant green as a skin marker has been suggested before, but a careful search through *The Quarterly Cumulative Index Medicus* has failed to reveal the article.

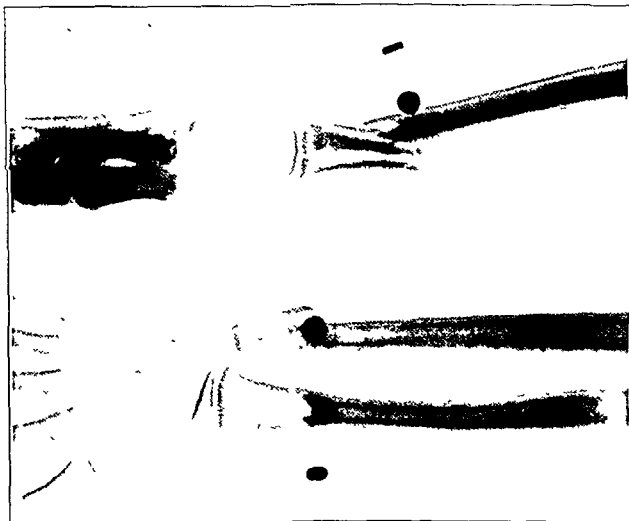


FIG. 1

Roentgenograms showing use of the artificial landmark. Closed reduction in this case was impossible because of interposition of fibrous tissue, which surrounded the upper fragment of the radius like a cot on a finger.

## SUMNER MEAD ROBERTS, A.B., M.D., F.A.C.S.

1898-1939

"It is a great thing to achieve peace between two men who quarrel. It is a greater thing to make peace between your body and spirit."\* Young as he was, Sumner Roberts had achieved this "greater thing", and his death by accident on November 19 has brought deep sorrow to those with whom he lived closely and to those whom he served with fidelity, integrity, and a skill tempered by wisdom.

Born in Dedham, Massachusetts, on January 25, 1898, the son of the eminent lawyer, Odin Roberts, and Ada (Mead) Roberts, he attended the public schools and later prepared for college at the Country Day School in Newton. At this famous pioneer school he was a member of the Student Council and of the football, baseball, and track teams. The year before he entered Harvard College in 1917 he spent at the Mesa School in Phoenix, Arizona. In his first year at Cambridge he was a member of the Freshman football and baseball squads. Then the Great War called him and he elected the Naval Service. As a preliminary training he shipped as a member of the crew on a South American cargo boat, and on his return entered the Naval Reserve Corps and was commissioned Ensign in the United States Navy. He was honorably discharged soon after the Armistice and resumed his academic studies at Harvard. In the summer of 1919, love of adventure and of the great spaces induced him to travel in company with Charles Thorndike to Hawaii. These students lived on the volcano of Kilauea and served as assistants to Prof. Jaggard, who was engaged in a study of the volcano's crater. Electing special courses in zoology and biology, he was graduated from Harvard with the class of 1921.

There followed four happy, hard-working, successful years at the Harvard Medical School, two years of surgical internship under Dr. Eugene H. Pool at the New York Hospital, and two more years of special training in orthopaedic surgery in the post-graduate course conducted by the Harvard Medical School, the Boston Children's Hospital, and the Massachusetts General Hospital.

On December 27, 1927, he was married to Elizabeth Converse, daughter of the distinguished musician and composer, Frederick S. Converse. His wife and three children survive him.

This quiet, strong, able orthopaedic surgeon soon began to impress the medical community in which he elected to practise his specialty in close association with Dr. Philip D. Wilson (now of New York), Dr. Francis C. Hall, and Dr. Robert B. Osgood.

Dr. Roberts' medical connections were many. He was a Fellow of the American College of Surgeons and of the American Academy of Orthopaedic Surgeons, a member of the American Medical Association, the Massachusetts Medical Society, the American Orthopaedic Association, and the Interurban Orthopaedic Club. At the time of his death he was president of the Boston Orthopaedic Club and Assistant in Orthopaedic Surgery at the Harvard Medical School. He held many hospital positions: He was Consultant in Orthopaedic Surgery to the Huntington Memorial and the Robert B. Brigham Hospitals and to the Massachusetts Eye and Ear Infirmary; he was also a member of the staffs of the Faulkner Hospital and the Dedham Clinic, and assistant visiting surgeon to the Orthopaedic Department of the Massachusetts General Hospital and a very active member of the "Fracture Service". It was at the Massachusetts General Hospital that the bulk of his public orthopaedic practice was conducted. Here the light shone brightest on his unusual abilities as a brilliant surgeon and a great teacher of undergraduate and postgraduate students. His contributions to medical literature were many and never encumbering. He wrote several monographs for textbooks of surgery and many outstanding articles for medical journals. His last contribution, in association with Dr. E. C. Vogt, dealt with an hitherto undescribed lesion of the lower leg, which they named "Pseudo Fracture of the Tibia".

\* Ha-Kohen, 1769.



He exhibited all the attributes of "The Compleat Angler" and was an amateur ornithologist of merit. An eager student of nature's ways, but with no lust to destroy, he managed better than most men to keep his "Toil unsevered from tranquility". He was the embodiment of a kindly calmness which his patients often spoke of as "priest-like": it blessed them with comfort and inspired them with confidence. His natural reserve was friendly, untinged by self-esteem. His criticism of himself was severe, of his colleagues very rare and then always just and gentle. Those who knew him well realized how far he had gone along a straight road to dignified eminence. They felt assured that in the near future he would be generally recognized as one of the great exponents of the specialty of orthopaedic surgery: great in learning, in judgment, and in skill.

Isocrates, the Athenian philosopher, once asked a question and answered it: "Whom then do I call educated? First those who control circumstances instead of being mastered by them; those who meet all occasions manfully and act in accordance with intelligent thinking; those who are honorable in all dealings, who treat good-naturedly persons and things that are disagreeable; and furthermore those who hold their pleasures under control and are not overcome by misfortune; finally those who are not spoiled by success."

Sumner Roberts was an educated man; these ideals of conduct he exemplified in his life. "The Spirit shall cease to be never; Birthless and deathless and changeless Remaineth the Spirit forever, Death hath not touched it at all." \*

\* Bhagavad Gita.

# News Notes

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The Eighth Annual Convention of **The American Academy of Orthopaedic Surgeons** will be held in Boston, Massachusetts, on January 22, 23, 24, and 25, 1940, under the presidency of Dr. George E. Bennett of Baltimore. The headquarters will be the Hotel Statler. The following scientific program has been arranged:

## TUESDAY, JANUARY 23

Symposium on Tuberculosis of the Spine—A. Bruce Gill, M.D., Philadelphia, Pennsylvania, *Chairman*.

Pathology.

J. Albert Key, M.D., St. Louis, Missouri.

Pathogenesis and Medical Treatment.

James B. Amberson, Jr., M.D., New York, N. Y. (By invitation.)

End Results of Treatment.

Walker E. Swift, M.D., New York, N. Y.

Mather Cleveland, M.D., New York, N. Y.

Henry W. Meyerding, M.D., Rochester, Minnesota.

Fremont A. Chandler, M.D., Chicago, Illinois.

Z. B. Adams, M.D., Boston, Massachusetts.

Robert I. Harris, M.B., Toronto, Ontario, Canada. (By invitation.)

Leo Mayer, M.D., New York, N. Y.

Paul P. Swett, M.D., Hartford, Connecticut.

General Discussion.

Closing Remarks by the Chairman.

Syphilitic Lesions of Bones and Joints.

Edwin D. Weinberg, M.D., Baltimore, Maryland. (By invitation.)

Malignant Joint Tumors (Synoviomata).

Dominic A. De Santo, M.D., New York, N. Y.

## WEDNESDAY, JANUARY 24

Tuberculosis of the Large Long Bones of the Extremities.

W. B. Carrell, M.D., Dallas, Texas.

Attainment of Good Posture by Use of Natural Reflex Mechanisms.

Royal S. Haynes, M.D., New York, N. Y. (By invitation.)

A Program for the Care of Crippled Children in New York City.

Vernon Lippard, M.D., New York, N. Y. (By invitation.)

President's Address.

George E. Bennett, M.D., Baltimore, Maryland.

Treatment of Osteogenic Sarcoma.

Albert B. Ferguson, M.D., New York, N. Y. (By invitation.)

Treatment of the Cerebral Palsies.

Winthrop M. Phelps, M.D., Baltimore, Maryland.

Malignant Tumors of Bone.

Charles F. Geschickter, M.D., Baltimore, Maryland.

The Conservative Treatment of Poliomyelitis with Paralysis.

Raymond E. Lenhard, M.D., Baltimore, Maryland.

Fat Embolism.

Carlo S. Scuderi, M.D., Chicago, Illinois.

Surgical Approach in Supracondylar T Fractures of the Humerus Requiring Open Reduction.

George W. Van Gorder M.D., Boston, Massachusetts.

The Treatment of Cavus Feet from a Conservative and an Operative Point of View.

Albert H. Brewster, M.D., Boston, Massachusetts.

The Treatment of Congenital Flat-Foot by Astragalar Shortening.

J. Warren White, M.D., Greenville, North Carolina.

Lambrinudi Operation.

Vernon L. Hart, M.D., Minneapolis, Minnesota.

Congenital Amputation.

Henry Kessler, M.D., Newark, New Jersey.

Amputation through the Knee Joint.

S. Perry Rogers, M.D., Chicago, Illinois.

#### THURSDAY, JANUARY 25

Epiphyseal Growth Disturbance Following Trauma.

Clay Ray Murray, M.D., New York, N. Y.

Fracture of the Neck of the Femur in Children.

John C. Wilson, M.D., Los Angeles, California.

Restoration of Function in Fractures of the Tibial Plateau Complicated by Injuries of the Semilunar Cartilages.

Guy M. Leadbetter, M.D., and Frank M. Hand, M.D., Washington, D. C.

Restoration of Physiological and Anatomical Function in Old Ununited Fractures of the Neck of the Femur.

Edward L. Compere, M.D., Chicago, Illinois.

Slipping of the Upper Femoral Epiphysis.

M. Beckett Howorth, M.D., New York, N. Y.

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The Annual Meeting of **The Orthopaedic Guild** was held in Cleveland, Ohio, on November 10 and 11, 1939, under the chairmanship of Dr. J. I. Kendrick. The next meeting will be held in New York, N. Y., in November 1940, under the chairmanship of Dr. R. L. Preston.

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The United States Chapter of the **International College of Surgeons** will hold its Fourth Annual Assembly, February 11 to 14, 1940, in Venice, Florida. In addition to prominent American speakers, professors of surgery from Brazil, Canada, Cuba, Mexico, and Turkey will lecture. Scientific and technical exhibits will be displayed in the patio of the Florida Medical Center. A well-rounded social program has been planned for the visiting surgeons, their wives, and guests. Further information may be obtained from Dr. Charles H. Arnold, Secretary to the Scientific Assembly, Terminal Building, Lincoln, Nebraska.

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The 1939 Fall Meeting of the **Minnesota-Dakota Orthopedic Club** was held in Minneapolis, Minnesota, on November 3 and 4. Members and their wives were entertained at the home of Dr. Edward T. Evans on the evening of November 3. On November 4 the clinical session was held at the Minneapolis General Hospital. At the business meeting Dr. Charles A. Reed of Minneapolis was elected President for the ensuing year and Dr. William A. Swedberg of Duluth was elected Secretary-Treasurer.

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The first meeting of a new orthopaedic society, named the **Orthopedic Forum**, was held at the Deshler-Wallick Hotel, Columbus, Ohio, on April 14, 1939. The organization is made up of fifteen of the younger orthopaedic surgeons of southern Ohio, southern Indiana, and West Virginia. The second meeting of the society was held at the Charleston General Hospital, Charleston, West Virginia, on September 25, 1939. It was decided to hold the meetings twice a year, the next to take place in Dayton, Ohio, in April 1940.

At a recent meeting of the Executive Committee of the **British Orthopaedic Association**, the following orthopaedic surgeons were elected to Associate Membership:

Mr. J. P. M. Clark, 14 Woodbine Terrace, Leeds 6.  
 Mr. E. H. T. Hambly, 41 Albany Street, London, N. W. 1.  
 Mr. H. E. Harding, 92 Portland Place, London, W. 1.  
 Mr. G. E. Harris, The Heritage Craft Schools, Chailey, Sussex.

The following surgeons were elected to Full Membership:

Mr. A. M. Hendry, 120 Salisbury Road, Moseley, Birmingham.  
 Mr. Alex Millar, 8 Woodside Terrace, Glasgow, C. 3, Scotland.  
 Mr. H. Poston, 2 St. John Street, Manchester.  
 Mr. N. Ross Smith, 9 Poole Road, Bournemouth.

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**The Clinical Orthopaedic Society** held its Twenty-Seventh Annual Meeting on October 13 and 14, 1939, at Oklahoma City, Oklahoma, and Little Rock, Arkansas. A very interesting clinical program was given in each city under the supervision of the Oklahoma Clinical Orthopaedic Society and the Arkansas Medical School. Officers elected for the following year were: President: H. Earle Conwell, M.D.; Vice-President: C. A. Stone, M.D.; Secretary-Treasurer: M. O. Henry, M.D.

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For the third year the **Nemours Foundation** will award five or six one-year Fellowships to begin on or after July 1, 1940, for either laboratory or clinical studies on problems related to the crippled child. The term "crippled child" is used in its broadest sense. The amount of each individual award will be from \$1,000 to \$2,400 and will be determined on the basis of the previous training of the applicant and the type of research project selected. Application blanks will be forwarded upon request to the Secretary, Dr. A. R. Shands, Jr., 803 Delaware Trust Building, Wilmington, Delaware. All applications should be in the office of the Secretary by January 15, 1940.

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The Sixty-Eighth Annual Meeting of the **American Public Health Association** was held in Pittsburgh, October 17 to 20, 1939, and was attended by more than 2500 professional public-health workers from the United States, Canada, Cuba, Mexico, and five foreign countries. The program represented a complete index of all current occupations and activities of the modern public-health program. The syphilis-control program was discussed from many angles. A session on cancer was a high light. The discussions on professional education and public medical care were especially notable. The officers for 1939-1940 are as follows:

President: Edward S. Godfrey, Jr., M.D., Albany, New York  
 President-Elect: W. S. Leathers, M.D., Nashville, Tennessee  
 First Vice-President: Elisabeth L. Smellie, R.N., Ottawa, Ontario, Canada  
 Second Vice-President: Domingo F. Ramos, M.D., Habana, Cuba  
 Third Vice-President: Wilton L. Halverson, M.D., Pasadena, California  
 Treasurer: Louis I. Dublin, Ph.D., New York, N. Y.  
 Executive Secretary: Reginald M. Atwater, M.D., New York, N. Y.  
 Chairman of Executive Board: Abel Wolman, Dr. Eng., Baltimore, Maryland.

The Sixty-Ninth Annual Meeting of the Association will be held in Detroit, Michigan, in October 1940.

# Current Literature

HOSPITAL FOR THE RUPTURED AND CRIPPLED. A HISTORICAL SKETCH WRITTEN ON THE OCCASION OF THE SEVENTY-FIFTH ANNIVERSARY OF THE HOSPITAL. Fenwick Beekman, M.D. With a Foreword by Philip D. Wilson, M.D. Privately printed in New York, 1939. \$3.00.

On November 2, 1939, the Hospital for the Ruptured and Crippled celebrated its seventy-fifth anniversary. A most fitting part of the ceremony in commemoration of this event was the presentation of the history of the institution, written by Dr. Fenwick Beekman, with a Foreword by the present Surgeon-in-Chief, Dr. Philip D. Wilson.

Since this institution was the first of its kind in the United States to be organized for the treatment of orthopaedic conditions and is now one of the largest and most important hospitals in the country, this book is of value to all interested in orthopaedic surgery. The growth of this Hospital, from a capacity of twenty-eight beds in 1863, in the home of Dr. Knight, its founder and one of the real pioneers, to its present proportions and influence in the community is a token of the effort and of the ability of Dr. Knight and the eminent men who succeeded him.

The history of the Hospital is a record of the character and the achievements of the men who have served as directors of its surgical service, as well as of its financial and administrative departments. Especially interesting is the growth of this Hospital under the guidance of Dr. Virgil P. Gibney, who served as Surgeon-in-Chief for thirty-five years. It was during this period that orthopaedic surgery underwent so many changes and met so many difficult problems while establishing itself as a specialty in the field of surgery. The record of the achievements of this group of men, both surgeons and administrators, is a demonstration of their character and ability and should be an inspiration to those who have been chosen to carry on their work.

The book is privately printed, and copies may be obtained from Mr. E. A. B. Willmer, Superintendent of the Hospital for the Ruptured and Crippled, 321 East 42nd Street, New York, N. Y. The proceeds from its sale are to be donated to the Fund for a Convalescent Home.

DIE CHIRURGIE DES PRAKTISCHEN ARZTES (Surgery for the General Practitioner).

Prof. Dr. Erich Sonntag. 2. Aufl. Leipzig, Georg Thieme, 1939. 49 marks.

The second edition, somewhat improved and enlarged, appears eight years after the original presentation of the book. As its title indicates, it is intended primarily for the general practitioner, who may be called upon to render adequate emergency treatment, or, in the absence of hospital facilities, may be required to undertake more extensive surgical procedures of an urgent nature. The work makes no effort to achieve the all-inclusiveness of monographic writing, but it goes far beyond the didactic confines of an elementary textbook of surgery. While it covers the field of minor surgery, it includes many of the more urgent major surgical procedures. Without attempting the systematic analysis of symptom complexes or differential diagnosis, the author has briefly and clearly outlined the typical signs and symptoms of the various surgical conditions.

The volume is eminently practical. Every problem which may confront the general practitioner is considered in detail. Nothing is taken for granted. Necessary instruments are pictured. Methods of cleansing the hands, the sterilization of instruments and material, and the setting up of the operating chamber are described and excellently illustrated. The author's method of procedure in any given situation is discussed in a simple, commonsense manner. Alternative measures are not described, and the relative merits of one method over another are not discussed.

The volume consists of almost 1000 pages of material, divided into three main

sections. The first part contains chapters on asepsis, anaesthesia (especially local), hemostasis, transfusion, treatment of wounds, surgical infection, and surgery of the extremities. Over 40 per cent. of this part of the work is devoted to the subject of amputation and the treatment of fractures and dislocations. The second portion is given up to a discussion of surgery of the different organs of the body, including even the teeth. Almost 100 pages are dedicated to the consideration of the various common deformities, injuries, inflammation, and tumors of each of the individual parts of both upper and lower extremities. The third part of the book consists of a surgical pharmacopoeia. The drugs are grouped under the surgical symptoms for which they are most frequently indicated. Wherever necessary, appropriate prescription for the preparation of the drug is given. Although sketchy in outline, this part is valuable.

For the general practitioner, this book would seem to fill a very definite need. The reader gathers the impression of having at his side a trusty friend and guide, the chief of a service, instructing his younger assistants in a definite approach to a problem. He is not left to choose the proper one from a cold category of all the procedures, but is, rather, schooled in the methods of the author. For this very reason, however, the volume will not make as direct an appeal to the orthopaedic specialist. Although the chapters dealing with the extremities may be read with profit, a large part of the volume is necessarily concerned with the surgery of the viscera, toward which the interests of the orthopaedic surgeon are not primarily directed.

**THE PHYSIOLOGICAL BASIS OF MEDICAL PRACTICE.** A UNIVERSITY OF TORONTO TEXT IN APPLIED PHYSIOLOGY. Charles Herbert Best, M.A., M.D., D.Sc. (Lond.), F.R.S., F.R.C.P. (Canada), and Norman Burke Taylor, M.D., F.R.S. (Canada), F.R.C.S. (Edin.), F.R.C.P. (Canada), M.R.C.S. (Eng.), L.R.C.P. (Lond.). Ed. 2. Baltimore, The Williams and Wilkins Co., 1939. \$10.00.

The first edition of this "text in applied physiology" by two well-known professors of that subject in the University of Toronto was very favorably reviewed in the issue of *The Journal of Bone and Joint Surgery* for April 1937. The prediction made in that review, that "this will unquestionably become an important textbook in many medical schools", has been amply fulfilled. Since its first publication by William Wood and Company, it has been four times reprinted within two years, has become internationally famous, and is now one of the most widely used medical books.

In their preface to this second edition, the authors reiterate that their "text was written with the view of enabling the student to bring physiological principles into more intimate relationship with problems at the bedside". It is precisely this concept of disease which constitutes the basic excellence and illuminating inspiration of the work. For, in the larger sense, disease is itself a physiological process, a normal defensive reaction of the organism to deleterious agencies, extrinsic or intrinsic. The advance of medical treatment throughout the ages has represented a progressive recognition of this fundamental principle, aided by the discovery and development of new diagnostic laboratory methods and clinical techniques.

This remarkable volume, already familiar to most physicians, traverses the entire field of medical practice in nine sections and eighty-one chapters, each of which has been expertly revised and brought up to date. Particular attention is directed to the paragraphs on the oxidizing systems of living cells contributed by Dr. A. M. Wynne. The ninth section, on the special senses, is wholly new and has been added to this edition. In eight chapters it deals comprehensively with all phases of special sense physiology.

These additions have lengthened the work from 1519 to 1872 pages, but a greater increase has been avoided by judicious condensation of references. With the same purpose an index of illustrations has been omitted, but there is an admirable subject index. The illustrations, 497 in number, are all excellent and chiefly original cuts. The frontispiece, in colors, exhibits thirty-one different examples of blood corpuscles. Clear, logical, comprehensive, and readably written, this Canadian work continues to

constitute a most valuable and epochal contribution to the knowledge and rationale of human physiology in health and in disease, and to its correlation with clinical medicine.

**DISEASES OF THE FOOT.** Emil D. W. Hauser, M.S., M.D. With a Foreword by Sumner L. Koch, M.D. Philadelphia, W. B. Saunders Co., 1939. \$6.00.

This text represents a comprehensive study of foot diseases, extending over seventeen years. Its clinical material is based largely on more than 2000 cases from the author's private practice, as well as on his extensive observations in the Orthopaedic Department of The Mayo Clinic and as American-Scandinavian Fellow under Prof. Haglund of Stockholm. To this wealth of personal experience has been added a diligent searching of the literature with detailed references to leading articles dealing with every phase of the subject. Such a broad foundation of knowledge extends inevitably to a much wider variety of topics than is ordinarily included in the purely orthopaedic problem of foot disorders. Here, for instance, are found chapters on circulatory diseases, nerve diseases, skin diseases, and infections of the foot. The anatomical structures related to or causing foot strain are also discussed in chapters on ankle fractures, ruptures of calf muscles, and the relationship of postural disturbances and low-back pain to the foot.

The more strictly orthopaedic foot conditions are introduced by an analysis of their anatomy, embryology, and physiology with succeeding sections describing symptomatology and treatment. Technical details are outlined; precise directions for making arch supports and applying shoe corrections are given; and the use of braces and casts is discussed. Throughout these chapters there is a balance between the conservative measures which are generally advocated and the special indications for surgical interference. The choice of surgical methods is outlined in general form; and in the treatment of disorders of the toes, the preferred method is more specifically described. The author presents his own procedure for correcting severe hallux valgus by removal of the exostosis, by transplantation of the abductor hallucis to the base of the first phalanx, and by tenotomy of the shortened adductors through a separate lateral incision. Surgical considerations in relation to club-foot and paralytic cases are discussed, but the technique is not described in detail.

Other helpful chapters which should be mentioned are those devoted to accessory bones of the foot, arthrosis, and diseases and tumors of the foot. The chapter on special technique in the care of the feet has many practical suggestions for strapping, physical therapy, and unna-paste boots and walking casts. A word of praise should also be given to the selection of illustrations, which are of unusual quality. The color reproductions of circulatory disorders are excellent.

In general, it may be said that the most valuable aspects of this book are its completeness and its clarity. The author has presented a text which every general practitioner will value and which the orthopaedic specialist will find almost indispensable as a reference book.

**DIE ÜBERTRAGBARE KINDERLÄHMUNG MIT BESONDERER BERÜCKSICHTIGUNG DER ERFAHRUNGEN AUS DER KÖLNER EPIDEMIE 1938** (Infectious Infantile Paralysis with Especial Reference to the Cologne Epidemic of 1938). Prof. Dr. Hans Kleinschmidt. Leipzig, S. Hirzel, 1939. 17.80 marks.

The author, with the collaboration of his colleagues, has presented the findings obtained from a study of a group of cases of poliomyelitis seen in epidemic form in Cologne. The statement in the preface that, during 1938, there were reported throughout Germany a total of 5757 cases gives an idea of the extent of the disease. The reader is also prepared for the type of material in this book by the statement that ordinary textbook discussions have been avoided and an attempt has been made to describe individual features of the disease.

In a brief historical survey, Kleinschmidt mentions the principal epidemics which have occurred since the original description of the disease by Heine in 1838. He reviews the etiology, experimental pathology, and immunity and states the modern views on transmissibility of the disease to animals, the presence of the virus in the tissues, and the portal of entry of the virus into the body. Opinions are based, in a large measure, on investigations by American students.

In a chapter on the epidemiology and preventive hygienic measures, C. Coerper shows, in tabulated form, the incidence by age, sex, etc., in the Cologne epidemic. The total number of cases observed in the City of Cologne was 399; additional cases from the surrounding territory increased the total number to 551.

The pathological anatomy of the disease is described by H. Heinlein. The material available for study was obtained from forty-two autopsies. The principal points which are emphasized are the extent of involvement of the nervous system and the relative significance of the meningeal and the parenchymatous changes.

In a study of the endogenous basis of poliomyelitis, J. W. Camerer discusses the influence of age, sex, puberty, pregnancy, menstruation, the endocrine system, and neuropathy. An investigation of the influence of blood groups, subgroups, and blood factors by K. Riethmüller and M. Riethmüller disclosed that certain groups predominate in paralysis while other groups are usually absent in paralysis.

As contributory external factors in the causation of the disease, L. Gottberg mentions involvement of the mucosa of the nasal passages and the intestines and states that 42 per cent. of the patients were afflicted by such disturbances. Even more conclusive and impressive is the percentage of cases in which there was a history of antecedent trauma or of overexertion.

The clinical features of the early stage and of the non-paralytic forms are described by K. H. Schaefer. The clinical aspects of the paralytic stage are discussed by E. Hoen. In a study of contact cases—members of the families or personnel of institutions—J. W. Camerer and G. Joppich report a high incidence of abnormal spinal fluid. The question of abortive poliomyelitis is discussed by K. H. Schaefer.

Specific and non-specific forms of therapy, described by G. Joppich, include serum therapy, dietetic treatment, decompression by repeated lumbar puncture, roentgenotherapy, thermotherapy, medical remedies, ultraviolet light, and vitamins.

Orthopaedic measures, described by M. Hackenbroch, consist, in the early stages, in fixation of paralyzed muscles and physiotherapy, especially underwater gymnastics. In the later stages, in which deformity is present, the most important forms of treatment are corrective and reconstructive surgical procedures.

The most impressive feature of this book is the completeness of the study, which was made possible by the close cooperation of the contributors. In view of this, and because of their strict adherence to statistics, the work may well be considered to be free from prejudiced opinions. Controversy is limited to points in which the findings differ materially from those of other authorities on the subject. The reader may be disappointed by the discovery that nothing of a sensational or startling nature has been revealed by the study; in a measure, therefore, the disease is as mystifying as it was before. Such conclusions, however, do not detract from the value of the book as an important contribution to the study of poliomyelitis.

**FRACTURES.** Paul B. Magnuson, M.D., F.A.C.S. Ed. 3. Philadelphia, J. B. Lippincott Co., 1939. \$5.00.

In his first edition, the author aimed to give the practical treatment of fractures, beginning with the first-aid requirements and carrying the treatment through to its completion; in so doing, he drew largely from his own experience rather than from material in the literature. In recognition of the very great advance in the knowledge of fractures and the increased efficiency in methods of treatment, he has in this third edition elaborated the subject matter and brought it up to date. Because of the necessity of a complete re-



consideration of the reaction of different metals, and because of the special interest which has been centered on certain fractures as, for instance, intracapsular fracture of the neck of the femur, some of this material has been entirely rewritten. The author has followed closely the development of the improved methods of dealing with these injuries in recent years and has given freely of his knowledge. He states that he hopes that this third edition will reflect the attitude of those constructive surgical groups who are interested in the problem of the care of fractures.

As in the first edition, the author has used the anatomical grouping of fractures and dislocations, considering each of the bones in the different areas with the injuries to which they are subject. This grouping adds to the ease of reference and also of study of those fractures which involve more than one bone. The text is generously supplemented by excellent photographs, roentgenograms; and drawings.

The first four chapters are devoted to a discussion of the general fundamental data on which must be based the successful treatment of fractures, including a consideration of the pathology, the question of repair, and the equipment required by the various methods. The etiological factors, the clinical symptoms, the roentgenographic diagnosis, and the choice of methods and means of treatment are presented particularly clearly and concisely for a volume of this size. The usual displacements of the fragments which occur in different fractures are carefully described and illustrated by drawings and photographs. This is especially helpful in those fractures near or involving the joints. The author recognizes the necessity of an accurate diagnosis of the deformities in selecting the treatment which will ensure successful end results.

The general medical and surgical men of today have need of more accurate knowledge on this subject, particularly of practical knowledge, for the public, which has also been educated, demands a higher standard of results, and hospitalization with its special equipment and personnel is not available in all cases. This book presents in a concise, clear, and practical manner information which will be distinctly helpful to this group of physicians and surgeons.

**THE TREATMENT OF RHEUMATISM IN GENERAL PRACTICE.** W. S. C. Copeman, M.A., M.D., B.Ch. (Cantab.), F.R.C.P. (Lond.). Ed. 3. Baltimore, The Williams & Wilkins Co., 1939. \$4.00.

This third edition is superior to the other editions in that it is more comprehensive and seems to meet the needs of the student and the general practitioner more adequately. An excellent chapter on focal infection and an extremely good chapter on gout have been added. New improvements in treatment—such as “serial plasters”, which have been widely used in the United States and in England—have been included. Local anaesthesia in cases of fibrositis and roentgen-ray irradiation in what is called the “wide field” are considered. Particularly valuable is the short chapter on doctor and patient, which deals with the psychology of the patient’s outlook in chronic disease.

The comprehensive and detailed exposition of the treatment affords the reader a clear conception of the treatment of arthritis to date. The author shows a tolerance and open-mindedness in regard to the value of the various kinds of treatment which is refreshing. The book should be read by every general practitioner who is confronted by the problems incident to this disease.

**FOOT ORTHOPAEDICS.** Otto N. Schuster, Litt. B., Pod. G. Ed. 2. Edited by Maurice J. Lewi, M.D., and Herman Scheimberg, M.Cp. Albany, J. B. Lyon Co., 1939.

This book, evidently based on wide experience, is designed for the podiatrist, but any physician who has not made a special study of the subject will find the practical information which it contains very helpful in understanding and treating the common foot affections.

The author has presented a very clear and impartial statement of the generally

accepted status of the subject, and has given an excellent description of the anatomy and the physiology of the foot. The usual affections of the foot and the ankle are covered very completely. The characteristics and the clinical picture of each are described, and the methods of treatment—especially the mechanical measures—are presented in a clear and practical manner. Although surgery is not a part of the prescribed treatment, the author has included descriptions of a number of surgical procedures which are necessary in treating some of these affections. This, of course, gives the reader a more thorough understanding of the need for and the results of such measures.

The book is full of sound advice and practical suggestions. Of especial value is the portion dealing with foot plates, in which the author discusses their proper application and the indications and contra-indications for their use.

The podiatrist has a definite rôle in the treatment of many of the foot affections and, therefore, should have a thorough knowledge of the subject. This specialty has made progress and, in cooperation with the medical profession, it can be put on a sound basis. Within its scope it can be a distinct adjunct to the other specialties.

PRINCIPIOS FUNDAMENTALES DO TRATAMENTO DA PARALISIA INFANTIL. (MEMBRO INFERIOR.) F. E. Godoy Moreira. São Paulo, Empresa Gráfica da "Revista dos Tribunais", 1939.

The author discusses the subject of infantile paralysis under four headings: (1) general principles; (2) pathogenesis of the deformities; (3) prophylaxis and the treatment of the sequelae; and (4) general conclusions. In addition to presenting his own experience, he has also drawn generously on the literature, quoting the opinions of other writers and in this way giving an impartial and comprehensive survey of the treatment of this disease and its sequelae.

The operative procedures connected with the treatment and correction of these conditions are given especial attention. Both tendon transplantation and arthrodesis are discussed in detail, and the various methods are described and illustrated. The author enumerates not only the indications for operation, but also the contra-indications and states the ages at which the various surgical procedures can be performed most favorably. Large charts showing the different operations for arthrodesis afford an excellent opportunity for comparison. The concluding section of the book is devoted to a very extensive bibliography.

In this book the orthopaedic surgeon will find expert guidance in the choice of methods of treatment, as well as practical suggestions to aid in the operative technique.

TRATAT DE ORTOPEDIE CHIRURGICALĂ (Treatise on Orthopaedic Surgery). Al. D. Rădulescu. Cluj, Tipografia "Cartea Românească", 1939.

In recent years there have appeared a number of books on orthopaedic surgery written in several languages. Of these, this "Treatise on Orthopaedic Surgery", written in the Rumanian language, is probably one of the best. It is an encyclopaedia of orthopaedic surgery, embodying many features which make it an excellent text and a very good reference book. The book has about 1000 pages and contains numerous original illustrations,—line drawings, photographs, and roentgenographic reproductions. It is extremely well balanced, and every important problem of modern orthopaedic surgery is brought to light. The contributions of non-Rumanian surgeons, especially American and French, are well represented. Several original procedures by the author are given a deserved place throughout the text.

The book is divided into two parts. The first part consists of a very illuminating general description of the history, the evolution, the physiology, the histology, the mechanics, and the general principles of treatment of the locomotor apparatus. The second part, subdivided into twenty-six articles, is devoted to special problems of ortho-

reference to etiology. Thirty-one of these patients showed neurological symptoms such as atrophy, slight spasticity, or an atypical plantar response. Twenty-five (nearly 50 per cent.) had also a spina bifida occulta, but they did not show a greater incidence of neurological symptoms, and one must remember that many cases of spina bifida occulta occur without foot deformity. The writer concludes that claw-foot is the result of a lesion of the nervous system, possibly transient, and usually difficult to demonstrate.

For relief of slight or moderate deformity, transplantation of the peroneus longus to the peroneus brevis was done, occasionally in combination with other procedures. Out of fifty-one cases observed for more than six months, satisfactory results were obtained in thirty-eight; improvement was noted in ten; and three were unchanged. The operation is recommended in the moderately severe cases, particularly in those with torsion of the foot.—Walter P. Blount, M.D., Milwaukee, Wisconsin.

EPIPHYSIOLYSIS CAPITIS FEMORIS (COXA VARA EPIPHYSAREA), WITH SPECIAL REFERENCE TO BLOODLESS REPOSITION TREATMENT. Poul Lütken. *Acta Orthopaedica Scandinavica*, X, 119, 1939.

In the defense of the manipulative closed reduction of slipped femoral epiphyses, the author has collected 407 cases of this disease from the literature and has added twenty-four of his own. Out of this number, 207 from the first group and thirteen of the personal cases were treated by manipulation. Of the writer's cases, good results were obtained in seven; fair, in two; poor, in one; and bad, in three. Of the cases collected from the literature, the results were good in sixty-eight; fair, in fifty; poor, in fifty-three; and bad, in thirty-six. It is significant that in the author's cases the degree of displacement in the roentgenogram was considerable in several of the cases which were "improved" clinically. In two, the roentgenogram showed no change, but the result was "good". The writer holds that the manipulation is not to blame for the bad results. It is equally evident that it is not universally responsible for the good.—Walter P. Blount, M.D., Milwaukee, Wisconsin.

ON DEFECTS AND PSEUDARTHROSES OF THE BONY BRIDGE FOLLOWING PARASPINAL BONE TRANSPLANTATION IN GROWING RABBITS. G. Odelberg-Johnson. *Acta Orthopaedica Scandinavica*, X, 160, 1939.

The study of a series of rabbits in which there had been paraspinal implantations of autoplasmic bone showed that longitudinal growth of the bone bridge occurred at the site of joint-like defects which appeared in the grafts. These fracture defects occurred at the level of the axes of motion running through the intervertebral discs, and, according to the writer, are the result of stress from movement of the vertebral column. Similar defects having the appearance of epiphyseal lines were observed in two children, eight years old.—Walter P. Blount, M.D., Milwaukee, Wisconsin.

DIE INFEKTIOSEN KRANKHEITSPROZESSE DER KNIESCHEIBE (The Infectious Processes of the Patella). Sophus von Rosen. *Acta Orthopaedica Scandinavica*, X, Supplementum III, 1939.

This monographic exposition of patellar lesions includes an exhaustive review of the literature with a summary of opinions and tabular statistical studies of the results. Seven new cases of patellar tuberculosis and seven of osteomyelitis are reported in detail, as well as a number of miscellaneous lesions.

Patellar tuberculosis seems to begin in adult life as frequently as in childhood and may remain latent for years. Rupture into the knee joint is the rule, and complete recovery is very rare. The treatment should be total extirpation of the patella alone before the joint is involved. After the joint is involved, extirpation of the patella should be combined with arthrodesis of the knee joint.

Osteomyelitis of the patella usually begins in childhood. The chronic form occurs as frequently as the acute. In either type normal or good function may be obtained even after rupture into the knee joint, which is not unusual. The staphylococcus is the usual organism. Conservative operations on the patella are usually adequate, but, in the author's cases, complete extirpation gave excellent results. With removal of the patella, there was no secondary arthritis, and function was good whether or not the patella was partially regenerated.

The futility of attempting to differentiate between tuberculosis and osteomyelitis roentgenographically is illustrated by a series of splendid reproductions. In childhood there is also so much similarity between the roentgenographic appearance of either lesion and the normal for the age that roentgenograms of the other knee should be taken for comparison. Likewise, a roentgenogram in childhood suggesting Kohler's or Sinding-Larson disease may be only a variation of the normal.—*Walter P. Blount, M.D., Milwaukee, Wisconsin.*

ROENTGENTHÉRAPIE DANS LES MALADIES RHUMATISMALES. EXPÉRIENCE DE PLUS DE DIX ANS, FONDÉE SUR ENVIRON 5,000 CAS ET PLUS DE 30,000 SÉANCES. (Roentgenotherapy in Rheumatic Affections. Experience of More Than Ten Years, Based on Approximately 5,000 Cases and More Than 30,000 Treatments.) G. Kahlmeter. *Acta Radiologica*, XIX, 529, 1938.

During the years 1925 to 1937, the author treated many thousands of patients with so-called rheumatic affections, with excellent results. These included the various types of bursitis, tendonitis, peritendonitis, arthritis, peri-arthritis, gout, and intractable sciatica. Roentgenotherapy is particularly valuable in gout, acute gonococcal arthritis and peri-arthritis, septic arthritis, and the bursitides. In the various types of deforming arthritis, such as malum coxae senilis and spondylitis deformans, irradiation results in subjective relief, without change in the objective or roentgenographic findings.

Neither age, sex, the degree of involvement, nor the extent of the process affects the results, although the earlier treatment is begun, the more responsive is the condition. In the arthritides, as in sciatica, the pain is caused by the associated inflammatory and degenerative processes in the neighboring muscles. The value of irradiation lies in its sedative effect on these muscle insertions, as, for instance, in cases of peri-arthritis or peritendonitis.

The technique of treatment has been standardized and is presented in detail. For a field, ten by fifteen centimeters, the author advises a total irradiation of 1,000 roentgen units, given in divided doses of from 150 to 200 per treatment, at intervals of from two to three days. A second course may be administered after a rest period of from four to six weeks. A third course may be given after another rest period of from six to eight weeks. In cases of bursitis the author suggests an "abortive" treatment consisting of one to two courses of 200 roentgen units. For acute gonococcal arthritis the author recommends three to four courses of from seventy-five to 100 roentgen units, at intervals of from two to three days,—that is, the same total irradiation as for bursitis, but in smaller, more often repeated doses.—*Henry Milch, M.D., New York, N. Y.*

ON INSUFFICIENCY FRACTURES OF FEMUR AND TIBIA. C. J. Hansson. *Acta Radiologica*, XIX, 554, 1938.

One case of insufficiency fracture in the tibia and two cases in the femur are presented. These fractures resemble the march fracture, which occurs in the fifth metatarsal. They may be caused by direct injury or by excessive strain. Clinically, they are characterized by pain, which is exacerbated by bodily exertion and is relieved by rest. Roentgenographically, they appear as spindle-shaped thickening of the periosteum and the endosteum. Occasionally a small cortical fracture line may be seen. The possibility of confusing this condition with bone tumor makes its recognition important.—*Henry Milch, M.D., New York, N. Y.*

THE ARTHROGRAPHIC APPEARANCE OF THE LIGAMENTS OF THE KNEE JOINT. Knut Lindblom. *Acta Radiologica*, XIX, 582, 1938.

By a contrast-filling method, the author carried out studies on the normal and the pathological status of the cruciate and the collateral ligaments. When the knee is properly filled, defects in the anterior cruciate ligament can be readily diagnosed by the appearance of the arthrograms. The collateral ligaments are not visualized in normal cases, but where capsular ruptures occur, the injury to the collateral ligament is betrayed by leakage into the periarticular tissues.

The technique demands preliminary removal of joint blood or fluid by aspiration. Thereafter from ten to fifteen cubic centimeters of a mixture of four parts of 35-per-cent. perabrodil and one part of 0.5-per-cent. novocain is injected. Immediately after injection, the suprapatellar recess is compressed by a circular bandage. The knee is moved to ensure distribution of the fluid, and roentgenograms are taken immediately. The cruciate ligaments are best seen in lateral views. Following the injection, the patient is enjoined to keep the knee quiet for the rest of the day. Irritation, causing pain or hydrops, is rare and innocuous.—*Henry Milch, M.D., New York, N. Y.*

ÜBER DIE RÖNTGENBEHANDLUNG DER PERIARTHRITIS HUMEROSCAPULARIS (Roentgenotherapy in Scapulohumeral Periarthritis). S. Mustakallio. *Acta Radiologica*, XX, 22, 1939.

Of 200 cases of periarthritis, 113 were followed up. These included: fifteen acute cases (not over three weeks' duration), fifty-two chronic cases, thirty-five traumatic cases, and eleven cases of arthritis of the acromioclavicular joint.

The general technique of treatment consisted in giving 150 roentgen units at each of two sessions, with an interval between. With a voltage of 160 kilovolts and four milliamperes, at a distance of thirty centimeters, filtered through five-tenths of a millimeter of copper and one millimeter of aluminium, about thirty roentgen units per minute are delivered. One dose is given to the anterior region of the shoulder, and the second to the posterior region.

In the group of 113 patients, forty-nine received additional treatment, such as massage or hydrotherapy. The others received irradiation only. Six of the fifteen patients with acute cases were cured in one week; eleven, within three weeks; and fourteen were cured or relieved within six months. There was one recurrence. Seven of the fifty-two patients with chronic cases were cured in one week; twenty-four, within three weeks; and forty-seven were cured or relieved within six months. There were seven recurrences.

In the group of patients with traumatic periarthritis, only three were cured within one week; eight, within three weeks, and thirty-five were cured or relieved within six months. Of these thirty-five patients, twenty had auxiliary treatment. The cases of acromioclavicular arthritis provided the worst results: one patient was cured in one week; four were cured and five were relieved within six months. In the whole group of 113 cases, forty-four were cured within three weeks; seventy-one were cured and thirty-five were relieved within six months.—*Henry Milch, M.D., New York, N. Y.*

THE USE OF SULPHANILAMIDE IN ACUTE SUPPURATIVE ARTHRITIS DUE TO THE HEMOLYTIC STREPTOCOCCUS. Wesley W. Spink. *The American Journal of the Medical Sciences*, CXCVIII, 35, 1939.

In the case reported, there developed an acute glomerular nephritis with nitrogen retention, pneumonia, and suppurative arthritis of the knee after acute tonsillitis. On admission to the hospital, the patient was stuporous and acutely ill, and his temperature was 102 degrees. Roentgenographic examination of the chest showed density in the right upper lobe. The white blood count was 14,700. Sixty cubic centimeters of thick green pus was aspirated from the knee; this yielded a pure culture of beta-hemolytic streptococcus and showed many short chains of cocci, which were extracellular. The

patient was given forty grains of sulphanilamide daily for three days; then, sixty grains daily. The sulphanilamide in the synovial fluid was ten and eight-tenths milligrams per cent. and in the blood, twelve and four-tenths milligrams per cent. Four transfusions of blood were given. After the administration of sulphanilamide had been started, examination of fluid from the knee showed many cells filled with cocci, and during the third week the fluid was sterile. In the discussion it is stated that the drug was given orally and also injected in solution directly into the joint cavity. Four weeks after leaving the hospital the patient had no pain in the knee, and movement was not limited, but some swelling and muscle atrophy were still present.—*J. Albert Key, M.D., St. Louis, Missouri.*

**EXPERIMENTAL ARTHRITIS IN RABBITS PRODUCED WITH STREPTOCOCCI AND OTHER ORGANISMS.** Russell L. Cecil, D. Murray Angevine, and Sidney Rothbard. *The American Journal of the Medical Sciences*, CXCVIII, 463, Oct. 1939.

In the experiments reported, two cultures of Group-A hemolytic streptococci and one of streptococcus viridans were used. These were injected intravenously in rabbits in doses varying from one-tenth of a cubic centimeter to four cubic centimeters of an eighteen-hour broth culture. Seventy-six rabbits received single intravenous injections. It was found that a single injection of two cubic centimeters of broth culture was the most suitable dose: it produced arthritis in 68 per cent.; whereas, in thirteen additional rabbits that received one-tenth of a cubic centimeter of the broth culture, arthritis did not develop. In another group of thirty-nine rabbits, which received three injections of one-tenth, one, and two cubic centimeters of the broth culture at ten-day intervals, arthritis developed in thirty-six. Seventy-one animals were injected with other organisms. Streptococcus aureus produced arthritis in 76.5 per cent. Pneumococci and bacillus paratyphosus A also produced arthritis. In a group of 198 rabbits arthritis was noted in 130 shoulders, eighty-nine knees, forty-two elbows, thirty-nine wrists, twelve hips, eight interphalangeal joints, and six ankles. Aspiration of the joints yielded cultures of the organisms during the first week. Cultures at autopsy were usually sterile after the sixth week, and the synovial fluid tended to become clear. The arthritis was apparently of an acute pyogenic type, the severity of which varied directly with the amount of bacteria injected into the blood stream. After the acute symptoms had subsided, there persisted a relatively low grade of chronic arthritis, in which the microscopic sections closely resembled those in human rheumatoid arthritis. Of 147 rabbits in which streptococci were injected into various regions of the body, arthritis was produced in 12.2 per cent., most frequently after injections into the gums or sinuses. The arthritis appeared within a few days after the inoculation, and usually no further joints were involved after the streptococci had disappeared from the blood stream. It is emphasized that there is no specific synovial lesion in rheumatoid arthritis, and that the microscopic picture in chronic experimental streptococcal arthritis closely resembles that in rheumatoid arthritis.—*J. Albert Key, M.D., St. Louis, Missouri.*

**THE TREATMENT OF VOLKMANN'S ISCHAEMIC CONTRACTURE.** Henry W. Meyerding and Frank H. Krusen. *Annals of Surgery*, CX, 417, Sept. 1939.

The authors discuss in a general way Volkmann's ischaemic contracture and discuss the treatment, particularly the use of physical therapy. They state that 182 cases of this condition have been observed at The Mayo Clinic.

Volkmann's ischaemic contracture is usually associated with supracondylar fractures which have been treated by placing the arm in acute flexion. Hemorrhage and swelling, unreduced fragments, and constriction caused by tight dressings or casts impair or obstruct the circulation, producing ischaemia of the hand and forearm. To prevent the occurrence of this condition, the authors recommend elevation of the extremity, deferred reduction until the swelling has been reduced, and, if indicated, incision and drainage of large hematoma.

They emphasize the importance of physical therapy in the form of heat, massage, and manipulation. Such therapy, supplemented by the use of corrective splints and at times surgical treatment, has in practically all of their cases produced satisfactory results.—O. B. Bolibaugh, M.D., *San Francisco, California*.

**SOLITARY MYELOMA OF BONE. A CLINICAL AND PATHOLOGIC ENTITY.** Joseph G. Pasternack and Richey L. Waugh. *Annals of Surgery*, CX, 427, Sept. 1939.

Histological examination of the tumor by a competent pathologist and careful roentgenographic examination of the skeleton or complete and thorough necropsy are necessary to substantiate a diagnosis of solitary medullary myeloma. On the basis of these criteria, the authors have analyzed thirty cases of solitary myeloma, with or without subsequent generalization of the disease, collected from the literature, and have presented a very complete report of an additional case which they have observed for seven and one-half years. Data on these cases are shown in tabular form and include age, sex, primary site, roentgenographic appearance, Bence-Jones protein, duration, observation period, pain, swelling, pathological fracture, treatment, and progress.

The youngest patient was nineteen months old, and the oldest was sixty-eight years old. Excluding the infant, the average age was forty-nine years. Twenty of the patients were male and eleven were female. Pathological fractures occurred in 42 per cent. of the cases. The following bones were involved: femur, nine cases; ilium, seven cases; humerus, five cases; vertebra, four cases; maxilla, two cases; parietal bone, two cases; tibia, one case; and clavicle, one case. In 66 per cent. of the cases of solitary myeloma the roentgenographic appearance was that of giant-cell tumor or bone cyst. In most of the remaining cases the appearance suggested metastatic carcinoma. Treatment of the cases varied: roentgenotherapy, curettement, excision, and amputation were used.

In true solitary myeloma the prognosis is good. Five patients have been observed for from four to nine years and have remained cured or the disease has been arrested, and no secondary foci have developed.—O. B. Bolibaugh, M.D., *San Francisco, California*.

**AN OPERATION FOR THE CURE OF FLATFOOT.** Ben L. Schoolfield. *Annals of Surgery*, CX, 437, Sept. 1939.

The author believes that the essential pathology of flatfoot is outward rotation of the os calcis, due to a too-long or overstretched deltoid ligament. The symptoms are pain in the feet and fatigue on standing, due to strain incident to malalignment.

The author's operation to correct this condition consists in shortening the deltoid ligament. A curved incision is made behind and below the medial malleolus. The periosteum over the malleolus is incised transversely, and the incision is carried down vertically in front and behind. With a periosteal elevator, the periosteum is freed from the bone, the dissection is carried downward to the sustentaculum and forward to the navicular. The foot is then held in marked varus; this produces an overlapping of the periosteoligamentous flap, the excess of which is excised. The edges are sutured together with chromic catgut or kangaroo tendon. The skin is closed with dermal sutures. If the tendo achillis is short, it should be lengthened.

A plaster bandage is applied to the foot and is maintained for several weeks. Adhesive plaster straps are then applied to protect the ligament from strain. Thomas heels or braces, or both, are used to raise the medial sides of the heels when the patient begins to walk.

Since 1926 the author has performed twenty-five of these operations and has obtained highly satisfactory results in a majority of the cases.—O. B. Bolibaugh, M.D., *San Francisco, California*.

**THE TREATMENT OF ANKLE MALUNION. A STUDY OF END-RESULTS.** William R. Hamsa. *Annals of Surgery*, CX, 447, Sept. 1939.

Major or minor incongruities about the ankle joint, resulting from poor reduction of fractures in this locality, produce serious disability.

formity of the thighs of nine years' duration. There was marked bowing of the thighs, particularly of the right, with shortening of the right leg. Roentgenographic examination showed many circular radiolucent areas in the pelvis, diffuse osteoporosis of the femora, tibiae, and fibulae, and changes in the bones of the feet. The serum calcium, phosphorus, and protein were not remarkable, but the serum phosphatase was elevated. Biopsy of the left femur revealed replacement of the spongy bone and marrow cavities by very cellular fibrous tissue, in which numerous areas of osteoid tissue and spicules of calcified bone were scattered. Exploration of the neck revealed no evidence of parathyroid tumor.

Although the roentgenographic findings were rather characteristic of osteitis fibrosa cystica dependent upon hyperparathyroidism, the early age of onset, the blood chemistry, the absence of parathyroid tumor, and the normal urinary excretion of calcium and phosphorus were strongly against this diagnosis.—*Clark W. Heath, M.D., Cambridge, Massachusetts.*



amounts of Bence-Jones protein were present in the urine. An unusual finding was hypoproteinaemia. The Congo-red test was positive, showing 72 per cent. retention. Roentgenographic examination showed a mottled condition in the skull, ribs, and long bones. Autopsy revealed the presence of plasma cells in the bone marrow, liver, spleen, and elsewhere. There were deposits of amyloid in various bones, in the knee and acromioclavicular joints, and in the kidneys.

An additional case of a negro, thirty-eight years old, is mentioned. The patient had a history of arthritis of five years' duration. Biopsy revealed the presence of multiple myelomata. There were atypical deposits of amyloid in various parts of the body.—

*Clark W. Heath, M D, Cambridge, Massachusetts.*

**OSTEOCHONDRITIS DISSECANS OF THE HEAD OF THE FEMUR PARTIAL IDIOPATHIC ASEPTIC NECROSIS OF THE FEMORAL HEAD.** Ernst Freund. *Archives of Surgery*, XXXIX, 323, Sept 1939.

Because osteochondritis dissecans of the head of the femur had been so infrequently reported, the late Dr. Freund collected the cases in the literature, added the cases of six patients whom he had observed, and studied them rather carefully. It was his belief that the pathological changes fell into two classes, called by him osteochondritis dissecans and pseudo-osteochondritis dissecans. The first of these is characterized by a large area of subchondral necrosis isolated from the epiphysis by a continuous zone of fibrous tissue. The second is distinguished by small subchondral necrotic areas about which, in spite of attempted fusion with the adjacent bone, pseudarthrotic changes develop. Both of these conditions are produced by motion in the joint and could probably be avoided by adequate immobilization at the critical period of the process. The etiological factors productive of this necrosis are probably trauma and hereditary tendencies.—

*I. William Nachlas, M.D., Baltimore, Maryland.*

**ASEPTIC NECROSIS OF THE FEMORAL HEAD FOLLOWING TRAUMATIC DISLOCATION.** REPORT OF TWO CASES. Samuel Kleinberg. *Archives of Surgery*, XXXIX, 637, Oct. 1939.

Kleinberg has had two young patients with traumatic dislocation of the hip in whom aseptic necrosis of the femoral head subsequently developed. He was able to study one case roentgenographically and by operation and the other case by serial roentgenograms. It is his belief that the disturbance of the circulation incidental to the dislocation and the irritation of the synovial membrane resulting from the reduction led to the damage. He, therefore, feels that, following dislocation of the hip, it is desirable that the reduction be accomplished by gentle manipulation, that the patient be immobilized for several weeks in bed, and that subsequently weight-bearing be avoided through the medium of a walking Thomas caliper brace. During the year that this brace should be worn physical therapy may be utilized. Weight-bearing may be resumed when the roentgenograms show normal restoration of the femoral head.—*I. William Nachlas, M D, Baltimore, Maryland.*

**SCOLIOSIS FOLLOWING EMPYEMA.** Seth Selig and Ernest Arnheim. *Archives of Surgery*, XXXIX, 798, Nov. 1939

Of the patients receiving operative treatment for empyema between 1932 and 1936 at the Mt. Sinai Hospital, the authors were able to follow up sixty-five for study. Only two of these patients had severe scoliosis, while three had a slight curvature. In the other sixty patients no lateral spinal deformity developed. The authors noted that acute empyema with operation and healing within four months yielded no such deformities. Even in the cases of chronic empyema in which multiple operations were performed, there was no apparent reason for scoliotic sequelae. In a study of the develop-

ment of scoliosis in patients with operations for non-tuberculous empyema, it is noted in the literature that, following thoracoplasty, curvature of the spine toward the operated side takes place, while in empyema a curvature away from the affected side ensues.—

*I. William Nachlas, M.D., Baltimore, Maryland.*

ÜBER DIE SOGENANNTA ACHILLO-KALKANEODYNIE MIT BESONDERER BERÜCKSICHTIGUNG DER BURSITIS ACHILLEA (So-Called Achillocalcaneodynia with Special Reference to Bursitis Achillea). C. Büttner und A. Heidemann. *Bruns' Beiträge zur klinischen Chirurgie*, CLXX, 43, 1939.

The term "*Achillodynie*" was used by Albert, in 1893, to describe the circumscribed swelling at the insertion of the Achilles tendon. There are many different underlying causes of the condition, the presence of gonococci in the bursa achillea profunda being the most common. Schanz, in 1905, described a tendinitis achillea traumatica due to chronic strain after mountain climbing. Jakobsthal believed that in children between the ages of eleven and thirteen years traumatic slipping of the calcaneal epiphysis should be considered. Haglund, in 1928, described three different pathological conditions: (1) changes in the Achilles tendon, such as tendovaginitis crepitans due to trauma or infection; (2) bursitis at the tendon insertion,—bursitis achillea posterior due to pressure of inadequate shoes (*Schuhgeschwulst*), which sometimes requires operation, and bursitis achillea anterior with chronic inflammation, severe pain, swelling on both sides of the tendon, and occasional crepitation or fluctuation; and (3) epiphyseal disturbances analogous to Schlatter's disease.—*Ernest H. Bettmann, M.D., White Plains, New York.*

AKTINOMYKOSE DER WIRBELSÄULE (Actinomycosis of the Spine). K. Huchzermeyer. *Bruns' Beiträge zur klinischen Chirurgie*, CLXX, 121, 1939.

The author reports two cases with hematogenous spread, in which no primary focus could be found. The first case was that of a woman, thirty-three years old, who suffered from persistent pain in the region of the right kidney, culminating in colicky pain below the right twelfth anterior rib. The temperature was 100.4 degrees Fahrenheit. There was palpable resistance in the right hypogastric region. Operation for atypical appendicitis revealed no pathology. A few days later, because of the development of a psoas contracture, an extraperitoneal incision was made. This disclosed a retroperitoneal abscess originating at the second lumbar vertebra, which showed an area of destruction the size of a cherry stone. The other case was that of a woman, thirty-three years old, who had lost twenty pounds during the preceding two years and who had severe pain in the right hypogastrium, leukocytosis, and secondary anaemia. In this case the correct diagnosis was made before operation and was based on the following roentgenographic findings: the corrugated appearance of the spongiosa and the convexity of the anterior border of the diseased vertebra. The abscess was opened, drained, and injected with iodoform-ether combined with potassium iodide, and roentgen-ray therapy was instituted.

—*Ernest H. Bettmann, M.D., White Plains, New York.*

ELF FÄLLE VON OSTEOMYELITIS DES FERSENBEINS (Eleven Cases of Calcaneal Osteomyelitis). Herbert Völkner. *Bruns' Beiträge zur klinischen Chirurgie*, CLXX, 229, Sept. 1939.

The course of osteomyelitis of the calcaneum differs from that of osteomyelitis localized in other bones. Since there is no tendency for spreading, a more conservative treatment is indicated. In the author's series of eleven cases, treatment consisted in curettage in three cases and simple incision and sequestrectomy in eight. As the infection is usually localized near the posterior epiphyseal line or at the superior surface near the insertion of the Achilles tendon, there is little tendency for spreading to other joints or for the formation of new foci. Clinically, oedema, tenderness, nocturnal pain, and

elevation of temperature were noted. In the differential diagnosis tuberculosis, periostitis, and trophoneurosis had to be considered. Usually a long period of immobilization was necessary. Experiences with cod-liver-oil packing were not encouraging. The duration of treatment was from four to twenty months. The functional end results were satisfactory; the patients were able to walk without discomfort, wearing orthopaedic shoes or shoes with special arch supports.—*Ernest H. Bettmann, M.D., White Plains, New York.*

**INTRASPINAL PROTRUSIONS OF THE INTERVERTEBRAL DISCS: ROENTGENOGRAPHIC FINDINGS.** Kenneth S. Davis. *California and Western Medicine*, LI, 230, Oct. 1939.

After presenting the subject of intraspinal protrusion of dislocated portions of the intervertebral discs and the nucleus pulposus, the author discusses the differential diagnosis. He stresses the necessity of examination of the spinal fluid and the use of the Queckenstedt and the "reverse-Queckenstedt" tests. As a final diagnostic test, in a patient who will evidently come to operation, the injection of five cubic centimeters of lipiodol into the intraspinal subarachnoid space is recommended. The blocking is demonstrated by placing the patient in the prone position on a tilting fluoroscopic table, with the head elevated 20 or 25 degrees; the table is then gradually tilted downward. The movement of the lipiodol is observed by the fluoroscope and roentgenograms. As lipiodol remains indefinitely, its use should be restricted to those cases in which operation is definitely indicated.—*Charles Lyle Hawk, M.D., Los Angeles, California.*

**THE PRINCIPLES OF TENDON SUTURE IN THE HANDS.** John Harold Couch. *The Canadian Medical Association Journal*, XLI, 27, 1939.

Dr. Couch states very clearly and succinctly the principles which govern the successful repair of a cut tendon: "(1) recognize it; (2) repair it; (3) repair it so that it stays repaired; (4) make it move." He points out that one should devote one's attention primarily not to the wound, but to the hand below the wound in order to discover what disability exists there. The author stresses the importance of proper apposition and the employment of suture material that is not bulky, that is strong, and that will maintain its strength over a period of three or more weeks. He, therefore, suggests linen or silk, and considers that No. 2 braided silk, having a strength of eleven pounds, is none too strong in view of the fact that a flexor tendon from the hand has a tensile strength of 100 pounds. He points out how useless it is to expect a tendon to move a finger, the joints of which are so stiff that it could not be moved, and states that the part involved should be kept free from splints with full flexion and full extension many times a day. These exercises should be vigorous and prolonged.—*D. E. Robertson, M.B., Toronto, Ontario, Canada.*

**CONSERVATIVE TREATMENT FOR FRACTURE OF THE OS CALCIS.** H. Gurth Pretty. *The Canadian Medical Association Journal*, XLI, 40, 1939.

Dr. Pretty presents still another method for treatment of fracture of the os calcis. The treatment is based on the disimpaction of the fragments, compression of the lateral spread, increase of the salient angle to normal, the prevention of submalleolar callus by compression, and, finally, the application of a special os calcis brace to enable the patient to return to light work. The author disimpacts the fragments by blows of a mallet, pounding over the lateral malleolus on a rolled-up towel. He then uses a Forrester clamp to compress the os calcis laterally. Ice tongs are then applied to the os calcis posterior to the line of fracture with traction on the ice tongs and countertraction made just posterior to the anterior end of the os calcis. In this way any subluxation of the bones of the metatarsal joint is overcome. When reduction is satisfactory, a plaster cast, with lateral compression pads over the os calcis in the submalleolar region, is applied. The period of post-reduction manipulation and care extends over nine months. The steps during this

period of after-care are rather complicated and require a great deal of attention, so that anyone interested in the method should read the original article for the technical details. The author concludes that this form of treatment has proved so far very satisfactory.—

*D. E. Robertson, M.B., Toronto, Ontario, Canada.*

**THE USE OF FASCIA LATA IN THE TREATMENT OF FALLEN METATARSAL ARCHES.** E. Earle Shouldice. *The Canadian Medical Association Journal*, XLI, 142, 1939.

Dr. Shouldice describes an operation for the relief of metatarsalgia, in which fascia lata is used to bind the fifth metatarsal to the first. A strip of fascia lata is placed around the neck of the fifth metatarsal, and is extended under the second, third, and fourth metatarsals to embrace the neck of the first. This strip is pulled sufficiently tight to narrow the foot materially, and the author claims that the procedure has given a narrower foot and has relieved pain in the region of the heads of the second and third metatarsals. He reports twelve operations with successful results.—*D. E. Robertson, M.B., Toronto, Ontario, Canada.*

**OSTEOCHONDRITIS DISSECANS.** R. C. Burr. *The Canadian Medical Association Journal*, XLI, 232, Sept. 1939.

The author reports three cases of osteochondritis dissecans: in two cases the lesion was in the ankle joint, and in one case it was in the knee. He gives a short description of the clinical findings, and discusses the etiology and the treatment.—*D. E. Robertson, M.B., Toronto, Ontario, Canada.*

**OSTEOPSATHYROSIS (FRAGILITAS OSSIUM).** H. H. McGarry. *The Canadian Medical Association Journal*, XLI, 354, Oct. 1939.

A case of osteogenesis imperfecta in a newborn infant is reported. The author gives a detailed history of the clinical condition and of the autopsy findings, which are interesting in that they support the theory of arrested development of the bone.—*D. E. Robertson, M.B., Toronto, Ontario, Canada.*

**CARCINOMA IN OSTEOMYELITIS.** C. M. Meng. *The Chinese Medical Journal*, LV, 505, 1939.

The writer reports three cases of chronic osteomyelitis in which carcinoma developed locally, and he notes the rare incidence of this condition, as recorded in surgical literature. Since the original report of thirty-nine cases by Devars in 1894, Benedict described twelve cases from the Massachusetts General Hospital in 1931, and Henderson and Swart added five more from The Mayo Clinic in 1936. It would appear from a study of a large series of cases that the occurrence of carcinoma in chronic osteomyelitis is between 0.2 and 0.5 per cent.

The lesions occur most frequently in the lower extremities,—in only three cases were they reported as being in the upper extremities. The age of the patient does not seem to be a determining factor, since one of Devar's patients was only thirteen years old, but, in general, it can be said that these lesions usually occur in individuals of cancer age and after the osteomyelitis has been present for over a year. The carcinomatous lesions are slow growing, are only locally malignant, and rarely cause metastases, so that local excision of the tumor may result in a permanent cure. In some instances, radium or high-voltage roentgenotherapy has been employed; while, in others, amputation has been necessary for a cure of the disease.

The author believes that in the presence of chronic inflammatory irritation of many years' duration, the normal regenerative processes of the epithelial cells may become so altered that neoplastic changes occur. The reason for the rare occurrence of the condition, however, is explained on the basis of a possible individual hereditary susceptibility to cancer.

In order to minimize the possibility of malignant change, the following procedures are recommended: (1) adequate drainage of all osteomyelitic foci; (2) wide incision of draining sinuses; (3) saucerization of bone cavities; (4) infrequent non-irritating dressings; (5) immobilization of the affected extremity in a plaster cast; and (6) skin-grafting of clean granulation areas to hasten epithelization. The author also feels that routine pathological examinations should be made following operations for osteomyelitis performed upon elderly individuals who have very chronic recurrent lesions.—*George W. Van Gorder, M.D., Boston, Massachusetts.*

ANTIGUA FRACTURA-LUXACIÓN COMPLICADA DEL TOBILLO. TRATAMIENTO RECONSTRUCTIVO. (Old Compound Fracture-Dislocation of the Ankle. Reconstructive Treatment.) Alberto Inclán. *Cirugía Ortopédica y Traumatología*, VII, 1, 1939.

Serious deformities following fractures are often seen, in spite of the great efforts being made to urge the general practitioner to prevent them. The author emphasizes the importance of the dictum that prevention is better than treatment, and presents a case which illustrates this very well.

Eight months before he was operated upon by the author, the patient sustained a compound fracture-dislocation of the ankle. Four months after the original injury, a severe infection developed in the ankle joint. When first seen by the author, the patient had a fair amount of infection and lymphangitis, which necessitated treatment for three months before he could be operated upon. Before operation the patient's ankle was in a position of total lateral dislocation with disorganization of the joint. The fibula was united in malposition with considerable shortening. At operation an osteotomy of the fibula was done with wide exposure of the inner side of the joint. The inferior surface of the tibia, along with the skin over the projecting portion, was excised. The upper surface of the astragalus was removed by a linear osteotomy; the astragalus and the tibia were aligned in good position, and a cast was applied. Three weeks after operation both incisions were dressed. The internal one had healed by primary intention, but that over the fibula showed some exuberant granulations, which were cauterized with silver nitrate. A second cast was applied. Six months following the operation the patient had an excellent result,—good fusion, complete healing of the infection, and ability to walk without crutches with good motion in the foot. At the time the article was written, two years and four months had elapsed since the operation, and the end result was very good.

The author discusses the treatment of compound fractures in general. If the fracture is seen within the first six hours, a thorough cleansing and débridement is done, the fracture is reduced, and the wound is closed without drainage or with only a very small drain, which is removed at the end of forty-eight hours. If the wound is seen after the first six hours, much the same procedure is carried out, only less débridement is performed, and the wound is left wide open instead of being sutured. The Orr treatment is employed. The author emphasizes the importance of aligning the fragments at once in cases of this type, rather than allowing them to go on to malunion in poor position. The article is accompanied by excellent illustrations of the case presented.—*Louis W. Breck, M.D., El Paso, Texas.*

UN NUEVO PROCEDIMIENTO EN EL TRATAMIENTO DE LAS FRACTURAS DE LA CLAVICULA (A New Procedure in the Treatment of Fractures of the Clavicle). José Chirinos. *Gaceta Peruana de Cirugía y Medicina*, II, No. 16, 1, 1939.

A detailed discussion of the bony and muscular anatomy of the region of the shoulder joint is given to bring out the importance of the clavicle in securing the shoulder and arm to the thorax. Under the clavicle is a triangular space with the clavicle at the vertex, in which lie the nerves and the blood vessels that run from the thorax to the arm. The author stresses the importance of this because of the danger that the clavicle may project downward into this space when it is fractured. Fractures of this bone may rarely be oc-

caused by direct violence; more frequently they are caused by a fall on the shoulder (indirect violence). The fractures are classified according to their various anatomical types. In fractures of the clavicle in general it is found that the proximal fragment is pulled upward by the sternocleidomastoid muscle, while the distal fragment is pulled downward and medially by the action of the muscles attached to the upper end of the humerus, especially the pectoralis major. The author quotes a fundamental postulate in the treatment of fractures,—that the broken bone should be replaced in good position without impeding the normal function of the neighboring organs. This cannot be accomplished satisfactorily in fractures of the clavicle, because of the very flexible nature of the structures about the shoulder girdle. On this account, innumerable methods of treatment have been proposed; the author mentions fifty-seven.

The author then describes his own method, which consists essentially in placing a screw in each fragment with an adjustable plate between the two screws to maintain reduction. The screws are inserted through the skin and into the bone without an open operation by means of special instruments. A nut is then placed on each screw to engage the plate, which has a channel along which slide the adjustable screws. A clamp is placed on each screw, and connecting the two is a threaded shaft with which distraction of the fragments may be accomplished. As soon as a satisfactory reduction has been obtained, the nuts on the bone screws are tightened to engage the plate securely, and reduction is thus maintained. The method appears to be not too complicated and at the same time practicable. No fixation is used postoperatively, and the patient is allowed moderately free movement at the shoulder. The apparatus is removed at the end of from ten to fifteen days. Photographs and roentgenograms of three cases show that very satisfactory reduction can be accomplished and maintained by this method.

The author describes in some detail the various advantages of his method, and most of his points are well taken. However, many American orthopaedic surgeons would object to at least two of them. He states that an operating room is not necessary for the insertion of the screws, and that the procedure is not difficult and can be used by any surgeon and not necessarily one trained in bone surgery.—*Louis W. Breck, M.D., El Paso, Texas.*

**AN EPIDEMIC OF POLIOMYELITIS IN WHICH BULBAR PARALYSIS OCCURRED WITH UNUSUAL FREQUENCY.** Ernest L. Stebbins, Edward E. Gillick, and Hollis S. Ingraham. *The Journal of the American Medical Association*, CXIII, 1559, Oct. 21, 1939.

Twenty cases of poliomyelitis occurring in the City of Niagara Falls, New York, during the two-month period from July 23 to September 20, 1938, are reported, in which a high incidence of bulbar involvement was noted. In thirteen of twenty cases a definite bulbar paralysis was observed, and twelve of these terminated fatally, a fatality rate of 60 per cent.

Spinal-fluid studies were made in eleven of the twenty cases, and moderately increased pressure was observed in all of them. Cell count varied from 17 to 450, and an increase of globulin was reported in nine cases.

Extensive peripheral paralysis was the usual finding, and only one non-paralytic case was observed, although a careful check was made for mild or abortive cases. A rapidly fatal bulbar paralysis followed the peripheral paralysis in the fatal cases with respiratory failure. In only two of the cases of bulbar type had tonsillectomy been performed. The etiology was proved by tissue study and the production of the typical disease in monkeys following inoculation with an emulsion of cord and brain stem taken at autopsy.

A careful epidemiological survey was carried out relative to nationality, geographic grouping in the City, proximity to the water front, economic status, previous health, contacts, milk supply, pets, public bathing facilities, and insect bites, but this study failed to reveal anything in common other than the water supply.—*Herschel Penn, M.D., Knoxville, Tennessee.*

EXCISION OF SCAPULA. REPORT OF CASE WITH EXCELLENT FUNCTIONAL RESULT. Edwin W. Ryerson. *The Journal of the American Medical Association*, CXIII, 1958, Nov. 25, 1939.

The author reports a case of metastatic carcinoma of the scapula, which presented on clinical and roentgenographic examination a picture resembling that of an osteogenic sarcoma. A resection of several inches of the transverse colon had been done six years previously for chronic obstruction said to have been due to carcinoma of the hepatic flexure. Perfect health had been enjoyed for four years, when gastro-intestinal symptoms reappeared, followed one year later by symptoms referable to the scapula, in the form of pain in the right upper arm and later swelling in the region of the scapula. An interscapular thoracic amputation was refused by the patient, who consented, however, to excision of the scapula; this was done, and the greater tuberosity of the humerus was attached to the clavicle. Fairly good function and position resulted, the patient being able to use this extremity in feeding himself and in writing, and complete relief from the severe pain was experienced.

The laboratory report was that of a metastatic glandular carcinoma, which in the scapula is relatively uncommon. Death occurred eight months later from generalized carcinomatosis.

The author states that had he been certain that the condition was due to metastatic carcinoma the operation might not have been performed, but relief from the unbearable pain seems to have justified it. He suggests that alcohol injection would be worth trying in a similar case for relief of pain.—*Herschel Penn, M.D., Knoxville, Tennessee.*

NEUROLOGIC ASPECTS OF HERNIATED NUCLEUS PULPOSUS AT THE FOURTH AND FIFTH LUMBAR INTERSPACES. R. Glen Spurling and F. Keith Bradford. *The Journal of the American Medical Association*, CXIII, 2019, Dec. 2, 1939

Disease or trauma of the intervertebral disc and the posterior longitudinal ligament usually precedes low-back pain with sciatic radiation caused by protrusion of the nucleus pulposus. The annulus fibrosus and the posterior longitudinal ligament are supplied by nerves from the lumbar plexus. True sciatic radiation is not caused by involvement of the ligamentous structures alone, but by the pressure of the prolapsed nucleus pulposus on nerve roots. In patients with disease of the annulus fibrosus, herniation is likely to occur in a posterolateral direction, because of the poor development of the posterior longitudinal ligament, which reinforces the annulus fibrosus

Prolapse in the fourth lumbar disc results in pressure on the fifth lumbar nerve. If it extends far laterally, compression of the fourth lumbar nerve at its foramen is found. If it extends medially, compressing the thecal sac from the side, in addition to the fifth lumbar nerve, the first and second sacral nerves will also be involved. Compression of one or more of these components gives rise to sciatic pain. Sciatic pain may result from compression of the fifth lumbar nerve or of the first sacral alone, producing both motor and sensory changes. Paraesthesia is far more frequent and important in accurate clinical localization when found with objective sensory changes.

The symptoms of prolapse of the nucleus pulposus at the fourth lumbar and the lumbosacral discs are pain low in the back and sciatic radiation, usually exaggerated by coughing or sneezing. Pain may be in the gluteal region, in the thigh, in back of the knee, or on the lateral aspect of the leg or of the ankle. The low-back pain may be variable or intermittent, and is intensified by bending or lifting or in torsion of the trunk. Paraesthesia of the thigh or of the leg is common. Muscle weakness is not found as a rule. A stiff lumbar spine is a prominent feature, but is not as important as a positive Lasègue sign, the hyperaesthesia, or the decreased or absent ankle jerk. A positive Naffziger sign is pathognomonic of intraspinal disease.

The authors point out that of nine consecutive cases in which operations were performed without confirmation of the diagnosis by contrast media, herniation of the nucleus pulposus was found in each. In the same three-month period iodized oil was used six

times with operation indicated in but two cases. They believe that their high incidence of positive results by operation is due to the better interpretation of the neurological picture.—*Henry H. Beckering, M.D., Dallas, Texas.*

THE DIAGNOSIS OF INTERVERTEBRAL DISK PROTRUSION BY INTRASPINAL INJECTION OF AIR. W. Edward Chamberlain and Barton R. Young. *The Journal of the American Medical Association*, CXIII, 1922, Dec. 2, 1939.

Air, when injected into the spinal canal, serves as an excellent contrast medium for visualization of space-taking lesions. A total of from forty to fifty cubic centimeters is injected, five cubic centimeters being injected at a time and five cubic centimeters of spinal fluid being removed each time. The success of the method depends on the proper technique and level of injection and good roentgenograms, which should be a little overexposed for better detail. Variations from simple indentations to complete block can be accurately demonstrated. In over 300 cases there was no error in diagnosis as proved by laminectomy.

The major advantage of air is that it is readily absorbed from the spinal canal and leaves no irritating foreign substance if operation is not done. The technique of injection, roentgenographic control, and interpretation of findings are discussed in detail.—

*Brandon Carrell, M.D., Dallas, Texas.*

THE ROENTGENOLOGIC DIAGNOSIS OF INTRASPINAL PROTRUSION OF INTERVERTEBRAL DISKS BY MEANS OF RADIOPAQUE OIL. John D. Camp. *The Journal of the American Medical Association*, CXIII, 1924, Dec. 2, 1939.

Protruded intervertebral discs are composed of fibrocartilage, portions of the nucleus pulposus, and, at times, portions of the notocord, all of which are not ordinarily opaque to the roentgen ray. For roentgenographic visualization, substances such as iodized oil, air, and oxygen, skiodan, and colloidal thorium oxide have been injected intrathecally as contrast media, and none of them have been entirely satisfactory. The use of iodized oil is indicated in those cases where a positive clinical diagnosis cannot be made or in those where a definite level is not determined. Varying amounts of iodized oil are used, the optimum being five cubic centimeters and the minimum, two cubic centimeters. Multiple discs may be overlooked with small amounts. Slow, continuous lumbar injection is employed, the oil being fresh and heated to 105 degrees. Fluoroscopic and plate control are used during injection, with the tilt tests to establish a definite level.

Sixty-five per cent. of the lesions seen roentgenographically are to one side or the other of the mid-line. Partial obstruction occurs in 11 per cent. of the cases; complete obstruction, in 2.5 per cent. In the remainder there are filling defects. Hypertrophy of the ligamentum flavum shows as a broad indentation in the oil. An oedematous nerve root will displace additional oil and produce additional deformity. Anomalies of the cul-de-sac should be recognized as such.

The authors report that out of 203 cases in which a preoperative roentgenographic diagnosis of protrusion of an intervertebral disc had been made, this diagnosis was confirmed at operation in 194.—*Henry H. Beckering, M.D., Dallas, Texas.*

PROTRUDED INTERVERTEBRAL DISKS WITH A NOTE REGARDING HYPERTROPHY OF LIGAMENTA FLAVA. J. Grafton Love. *The Journal of the American Medical Association*, CXIII, 1929, Dec. 2, 1939.

During the years 1935, 1936, and 1937, only 1.8 per cent. of over 300 patients seen at The Mayo Clinic by orthopaedic consultants for low-back pain and/or sciatic radiation underwent operation because of a diagnosis of protrusion of the intervertebral disc. The symptom complex presented by these patients was low-back pain with sciatic radiation, spasm of the lumbar muscles, loss of the normal lumbar lordosis, positive Lasègue and Kernig signs, sciatic tenderness, and decrease or absence of the tendo achillis reflex. If



the total spinal-fluid protein is elevated and the roentgenogram shows narrowing of the fourth or fifth lumbar intervertebral disc, the diagnosis is almost certain. The author usually relies on confirmation by an opaque intraspinal substance as seen roentgenographically, but he has recently operated on eleven patients with proved prolapsed discs despite the fact that roentgenographic findings were negative. Hypertrophy of the ligamentum flavum is usually associated with protrusion of an intervertebral disc; in only twelve patients was there hypertrophy of the ligament without an associated prolapsed disc.

Surgical treatment is advised and consists in the removal of the excessive portion of the prolapsed disc through a small laminectomy wound, great care being taken in the handling of the nerves and in hemostasis. Postoperative treatment is simple, no casts or splints are used, and patients are allowed as much freedom as possible. Frequent neurological examinations are made, and, if there is an increase in the findings, a postoperative hemorrhage should be ruled out. One postoperative hemorrhage and one postoperative death are reported.—*Brandon Carrell, M.D., Dallas, Texas.*

ACUTE OSTEOMYELITIS WITH STAPHYLOCOCCEMIA. A CLINICAL REPORT ON THE USE OF ANTITOXIN IN ITS TREATMENT. Lenox Dial Baker and Alfred Rives Shands, Jr. *The Journal of the American Medical Association*, CXIII, 2119, Dec. 9, 1939.

In this article attention is directed to the experimental and the clinical facts which indicate the value of staphylococcus serum in the treatment of acute osteomyelitis. Serological studies show that fatalities occurred in those individuals in whom no staphylococcus antitoxin was found in the blood stream. In those patients who recovered large quantities of antitoxin were found in the blood.

Upon administration of antitoxin intramuscularly a shift in the relation of young forms to old forms of polymorphonuclear leukocytes was observed, with a decrease in the number of young forms free in the blood stream. This shift was used as a guide in the treatment, and it is believed by the authors to be as accurate as serological tests and also more convenient.

Treatment consisted in an initial intramuscular dose of antitoxin followed by massive intravenous doses.

The production of toxin from the infected area must be stopped, as poor results followed failure to remove the site of infection. Wide excision, as in the Orr treatment, is recommended when possible.

The author also reports some work with sulphapyridine. Culture of the blood showed it to be free of bacteria shortly after the administration of this drug. Work on the relation of this drug to osteomyelitis has not yet been completed.—*W. C. Peterson, M.D., Dallas, Texas.*

RÉSULTATS ÉLOIGNÉS DE L'ABLATION CHIRURGICALE DES CORPS ÉTRANGERS ARTICULAIRES, D'APRÈS 31 CAS (Late Results from Removal of Foreign Bodies from Joints in Thirty-One Cases). R. Leriche, A. Jung, et Ch. Berthel. *Journal de Chirurgie*, LIV, 1, 1939.

The authors report the late results after the removal of foreign bodies in osteochondritis dissecans (twelve cases) and in synovial osteochondromatosis (eight cases), traumatic foreign bodies (nine cases), and loose bodies formed in arthritic joints (two cases). The time interval was from six months to twelve years. In the cases of osteochondritis dissecans the late results were excellent, and some healing of the defect was seen in many of them. Only three of these patients showed any chronic arthritis. Only three of the patients with osteochondromatosis had follow-up examinations; of these two had excellent results. In the third case all of the foreign bodies had not been removed, and further surgery was required. Five of the cases of foreign body due to intra-articular fractures were reexamined from three to ten years after operation and showed good results. Those cases which were due to arthritis were not reviewed.—*J. Albert Key, M.D., St. Louis, Missouri.*

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bone has thus been completely severed, each end has a saddle-like groove. The ends can then be introduced into each other with proper coaptation. The bone dust produced by the burring acts as a good hemostatic and also promotes local osteogenesis. The author calls his method "fenestrating osteotomy".—*Emanuel B. Kaplan, M.D., New York, N. Y.*

**GIANT CELL TUMOR OF BONE.** Bradley L. Coley. *The Medical Press and Circular*, CCII, 172, 1939.

The author presents a very comprehensive summary of our present knowledge of giant-cell tumor. It is usually a single lesion, and the location is generally at the ends of long bones of the extremities. The femur, the tibia, and the radius are most frequently involved. It begins in the epiphyseal region and extends progressively to destroy cancellous bone; it seldom invades the shaft.

The chief symptom is low-grade intermittent pain, often described as a "dull ache". Swelling is a very late symptom and physical finding.

Roentgenographic study reveals distinctive characteristics. There is a destructive area in the epiphyseal region, involving the metaphysis, but almost never the cortical bone. It is spheroid and shows coarse trabeculation. There is no new-bone proliferation, and seldom is there joint invasion.

Giant-cell tumor is to be differentiated from bone cyst, enchondroma, and osteolytic osteogenic sarcoma. Bone cyst occurs in childhood and early adolescence; it is always on the diaphyseal side of the epiphyseal line and is separated from this line by a bridge of bone. Enchondroma grows slower, seldom expands the cortex, and most often occurs in small long bones. Osteogenic sarcoma may present identical symptoms and physical findings, and often microscopic proof is necessary for early diagnosis.

Malignancy may occur in a giant-cell tumor, in which case it is not a true osteogenic tumor as it does not form bone, cartilage, or osteoid tissue. The author states that he has often seen malignancy develop in giant-cell tumors following the combined use of surgery and irradiation, and he strongly deprecates the practice of combining the two methods of treatment.

Surgery is probably the treatment of choice, although some sites may be inaccessible and there irradiation must be used. Irradiation may be carried out by radium packs or by the roentgen ray. The latter is preferable if irradiation is the treatment of choice and should be given in small doses repeated at frequent intervals and continued only so long as is indicated.

A description of a curettage technique is given, which emphasizes the careful, aseptic, thorough, and complete removal of tumor tissue, followed by complete wound closure and protection of the limb to prevent fracture.—*Herbert E. Hipps, M.D., Marlin, Texas.*

**OSTEOMYELITIS UND TRAUMA.** PATHOLOGISCH-ANATOMISCHE BETRACHTUNGEN. (Osteomyelitis and Trauma. Pathological-Anatomical Observations.) C. Froboese. *Monatsschrift für Unfallheilkunde und Versicherungsmedizin*, XLVI, 305, 1939.

After enumerating all the important factors which come to the attention of the pathologist in the study of osteomyelitis, the author concludes that the significance of trauma as an etiological or contributory influence cannot be determined with certainty.—

*R. J. Dittrich, M.D., Fort Scott, Kansas.*

**DIE MONTEGGIA-SCHÄDIGUNG (ELLENBRUCH MIT AUSRENKUNG DES SPEICHENKÖPFCHENS).** (Monteggia's Fracture (Fracture of Ulna with Dislocation of Head of Radius).] Friedrich Klages. *Monatsschrift für Unfallheilkunde und Versicherungsmedizin*, XLVI, 368, 1939.

This type of injury was seen in twelve patients during a period of eleven years. Reports of all cases are given, accompanied by eight roentgenograms. In three

patients with fresh injury, conservative treatment, consisting in reduction both of the fracture and of the dislocation, was successful and resulted in normal or good function.

In two cases of fresh injury, closed reduction was unsuccessful and operative treatment was employed. In the first case, reposition was easily accomplished. In the second case, it was necessary to resect the radial head. Complete restoration of function followed this form of treatment.

In six cases of old injury (two to eleven months), operative reduction was satisfactory in two instances.

The article contains an extensive discussion of the mechanism of the injury, the diagnosis, and the various forms of treatment which are employed.—*R. J. Dittrich, M.D., Fort Scott, Kansas*

**DIE BEDEUTUNG DER ZEHE** (The Function of the Toes). Otto Mayr. *Monatsschrift für Unfallheilkunde und Versicherungsmedizin*, XLVI, 421, 1939.

The author discusses the anatomical and functional aspects of the toes from the standpoint of the influence of these structures, not only on the foot, but also on the static and postural relations of the entire body. Considering first the rôle played by the toes in the normal foot, as determined from anatomical and roentgenographic studies, an analysis is made of eighteen cases in which one or more toes had been amputated. This study embraces the clinical symptoms and the physical and roentgenographic findings. The conclusion is reached that amputation of one or more toes is usually followed by serious disability and should, therefore, be avoided if possible.—*R. J. Dittrich, M.D., Fort Scott, Kansas.*

**ANATOMICAL APPROACHES AND OPERATIVE TECHNIQUE OF FRACTURES OF THE BONES OF THE FOREARM.** G. D. Bolotine. *Orthopaedia i Travmatologia*, XIII, 42, 1939.

In the experience of the Ukrainian Central Institute of Orthopaedics and Traumatology, fractures of the bones of the forearm are treated as a rule conservatively, but, in a number of cases, closed reduction has been found unsatisfactory. An attempt has, therefore, been made to establish definite rules for surgical treatment, and the classification of Masmonteil has been adopted. This includes diverging displacement of the distal or of the proximal fragments combined with converging displacement of the opposite fragments and rotational displacements and parallel displacements with obliteration of the interosseous space. Certain isolated fractures of the radius and of the ulna are also included in this series.

In order to avoid the frequently encountered non-union, the author emphasizes the importance of the proper technique and especially the choice of correctly placed anatomical approaches. Several incisions are described, but Cadenat's approaches, which he described in the *Bulletins et Mémoires de Chirurgie* in 1937 and in the *Journal de Chirurgie* in 1929, are considered most satisfactory. The author states that the method of cerclage with a steel wire for oblique fractures and combined with a beef-bone graft for transverse fractures has been used in the Institute with satisfactory results.—*Emanuel B. Kaplan, M.D., New York, N. Y.*

**LA CLEF DU DIAGNOSTIC PRÉCOCE DE LA SPONDYLARTHRITE EST DANS LA RADIOGRAPHIE DES ARTICULATIONS SACRO-ILIAQUES** (The Key to the Early Diagnosis of Spondylarthritis Is in Roentgenography of the Sacro-Iliac Joints). J. Forestier et J. Metzger. *La Presse Médicale*, XLVII, 1247, 1939.

The authors are of the opinion that the key to the early diagnosis of the ankylosing spondylarthritis of Marie is the roentgenographic appearance of the sacro-iliac joints. Of 159 cases which they studied, the characteristic picture was observed in all but two. In twelve cases which they studied before evidence of spinal involvement appeared, the

following facts were elicited. With one exception, all patients were men and under the age of thirty years. One third gave a history of gonorrhoea. The majority of patients had suffered pain for a period of less than four years. All complained of back pain, with radicular radiation. There was some stiffness of the spine, with tenderness on percussion over the spinous processes and sciatica. None of the patients had any symptoms referable to the sacro-iliac joints, yet roentgenographic examination showed characteristic changes in the sacro-iliac joints.

These changes may be divided into three phases: (1) decalcification of the bones, with apparent widening of the joint; (2) irregular mottling, which the author calls "tiger-ing"; and (3) synostosis, with transverse fibrillation and sclerosis of the sacro-iliac joint. Calcification of the iliolumbar ligaments may be concomitant.

On the basis of these pictures, with symptoms of radiating back pain, the author believes the differential diagnosis of early ankylosing spondylarthritis may confidently be made.—*Henry Milch, M.D., New York, N. Y.*

LE SYNDROME DU NEUROGLIOME DE LERICHE. SON IMPORTANCE ET SES CONSÉQUENCES MÉDICO-LÉGALES CHEZ LES GRANDS AMPUTÉS. (Leriche's Neuroglioma Syndrome. Its Importance and Its Medicolegal Consequences in Extensive Amputations.) P.-H. Descoust. *La Presse Médicale*, XLVII, 1279, 1939.

An increasing number of patients previously subjected to amputation present themselves with disability other than that occasioned by the amputation. Anginal pain, hypertension, and other vasomotor disturbances, which characterize the condition, are classed by the author in the large neuroglioma group described by Leriche at the meeting of the *Union Fédérative des Médecins de Réserve* in March 1939. These are believed to be caused by a reflex action on the sympathetic nervous system, through which their action on the cardiac plexus is controlled. The designation "cardiac trouble in amputation patients" indicates a real clinical condition, provided any other organic cause of the cardiac symptoms can be eliminated.

The author readily admits that the fact that this is not an invariable consequence of amputation indicates that the patients in whom these symptoms do develop are probably neuropathic. The differentiation between the organic and the psychic cases can, of course, be made only after careful study, preferably in the hospital. However, the subsidence of symptoms after novocain injection of the nerve in the amputation stump is suggestive of the origin of the cardiac disturbances. In such cases the vicious cycle may be interrupted by injections of the stellate or lumbar ganglion, or by ganglionectomy.—

*Henry Milch, M.D., New York, N. Y.*

MOIGNONS UTILES ET MOIGNONS INUTILISABLES (Useful and Useless Amputation Stumps). René Leriche. *La Presse Médicale*, XLVII, 1333, Sept. 13, 1939; 1350, Sept. 20, 1939.

The author states that exact information is available on a series of 80,000 amputations performed during the World War from 1914 to 1918. Within two years from two to four reamputations had been performed in 16 per cent. of the cases; 31 per cent. of the stumps had had to be reoperated upon; and 50 per cent. of the lower-extremity stumps had had to be revised for prosthetic reasons. Although a number of these secondary operations were justified by osteitis or vicious scar formation, a great many were improperly performed. Particularly in respect to the length of stump should surgical opinion be revised. Amputation must be performed, not with regard to tissue economy, but with respect to function and the possibility of the subsequent use of a prosthesis.

For each segment of the extremity there is an optimum length, corresponding in general to a section of bone between the middle and the distal extremity of the middle third of the diaphysis. With respect to the validity of a stump, the opinion of the prosthetic mechanic is preferable to that of the surgeon. Chopart's amputation, the

various osteoplastic amputations, disarticulations at the knee, and the Gritti operation are all bad.

If the foot must be sacrificed beyond the tarsometatarsal joint, Syme's amputation is the operation of choice. Lisfranc's amputation and intertarsal amputations in front of Chopart's joint are good for forefoot amputations. In the leg the best amputation is performed in the lower third of the tibia, with higher amputation of the fibula. No leg amputations should be performed at a point less than eight centimeters from the tip of the patella. The most favorable site for amputation of the femur is in its mid-third, below the middle of the thigh and above the lower quarter. In the upper extremity, with certain restrictions, an effort should be made to amputate as far distally as possible. All disarticulations, except those at the carpometacarpal joint, are considered ill advised. Even wrist disarticulation is bad and should be replaced by lower-forearm amputation.

In the forearm, ablation of the bones may be performed within an area lying ten centimeters below the tip of the olecranon and six centimeters above the wrist joint. In the arms, as in the femur, the site of election is in the lower third, a little below the middle. The saw should not go below a point five centimeters from the articular interline of the elbow, and, if possible, it should not go above a point fifteen centimeters from the acromion. In general, an anterior flap should be made. Nerve section is performed only after novocain and alcohol or phenol injection. Care should be taken to prevent loss of blood, and, in traumatic cases, the wounds should be left wide open.—*Henry Milch, M.D., New York, N. Y.*

#### BONE RAREFACTION AFTER TRAUMA TO LARGE JOINT REGIONS WITHOUT FRACTURE.

Henry L. Jaffe. *Radiology*, XXXIII, 305, Sept. 1939.

Trauma, often mild in degree, to the neighborhood of large joints may, without causing fracture, produce severe muscle atrophy; occasionally it may also cause marked bone atrophy, involving all the bones forming the joint and affecting both spongiosa and cortex. This condition is most common at the knee, and is probably analogous to Sudeck's atrophy. There is usually present some vasomotor and trophic disturbance of the skin. This post-traumatic bone atrophy has frequently led to a diagnosis of tuberculous disease or of bone tumor.

Roentgenographically, the atrophy extends a considerable distance along the shafts of both proximal and distal bones, which present an obfuscated, cloudy, somewhat mottled, ground-glass appearance. There is no periosteal new-bone formation.

Microscopic study shows rarefaction distributed throughout the thickness of the cortex, with enlarged and coalesced vessel spaces in some areas and with resorption and new-bone deposition on the walls of large cortical spaces in other areas.

The pathogenesis is unknown, but it is probably the same for the soft-tissue changes as it is for the bone changes, and seems to be in the field of neurovascular dynamics. This condition is not the result of disuse; it may develop despite continued use. Unlike bone atrophied by disuse, the bone under discussion is characterized by numerous dilated and engorged blood vessels. This hyperaemia is certainly a factor in the enlargement and erosion of the haversian canals, and is itself probably due to a reflex paralysis of the vessel walls.

Recovery is very slow and is favored by active use of the affected part.—*Edward N. Reed, M.D., Santa Monica, California.*

#### THE IMPORTANCE OF SACRO-ILIAC CHANGES IN THE EARLY DIAGNOSIS OF ANKYLOSING SPONDYLARTHRITIS. MARIE-STRÜMPFEL-BECHTEREW DISEASE. Jacques Forestier. *Radiology*, XXXIII, 389, Sept. 1939.

It is generally accepted that this disease starts as an atrophic arthritis of the joints between the facets of vertebrae, which, after an inflammatory stage, undergo bony ankylosis, with later ossification of the ligaments. In the early stages there is vague low-back pain or pain radiating around chest and abdomen. If diagnosed early, ankylosis

can be avoided. The age at onset is usually between eighteen and twenty-five years, and males are affected almost exclusively. Sixty per cent. of the patients have a history of past genito-urinary ailment, not always gonococcal, and over 80 per cent show an increased sedimentation rate.

Roentgenographically, the bony bridging between the vertebrae appears late in the course of the disease. Changes in the sacro-iliac joints are visible early, and lead to complete bony ankylosis. Early roentgenograms of patients in whom formation of the typical "bamboo spine" later occurred show changes in the sacro-iliac joints before any abnormality is noted in the spine. First there is pseudo widening of the joint space, the subchondral bone becoming woolly and hazy through decalcification. After several months or a year, a mottled appearance of the contiguous portions of both sacrum and ilium develops. The terminal stage is characterized by loss of joint space and synostosis, and is generally contemporary with ossification between the vertebrae. The sacro-iliac changes may be unilateral or bilateral, and they may involve part of or the entire joint.

The author believes that the primary focus in ankylosing spondylarthritis is the genito-urinary system or the lower bowel. The toxic products from this focus drain into the lymphatic system of the pelvis, contiguous to the sacro-iliac joints, and thence along the spine, just in front of the apophyseal joints, with which they have many connections. This is believed to explain the slow progression of the disease from the sacro-iliac joints upward along the spine.

Treatment consists in rest, fixation, and physiotherapy. In addition, the author has found of great therapeutic value: (1) treatment by injection of gold salts (chrysotherapy), as in atrophic arthritis, and (2) injections of radio-active preparations (thorium X or radon). Details of this mode of treatment are given, and the result is declared to be most satisfactory.—*Edward N. Reed, M.D., Santa Monica, California.*

#### FRACURES OF THE NECK OF THE FEMUR L. Henry Garland and Harold A. Hill. *Radiology*, XXXIII, 421, Oct. 1939.

The authors believe that the most important consideration in fractures of the femoral neck is the direction of the fracture line as seen in the anteroposterior roentgenogram. The more vertical the fracture line, the greater the shearing strain. This consideration influences the prognosis: in cases in which the fracture line approaches the horizontal, there is a tendency to firm bony union; while in cases in which the fracture line approaches the vertical, slipping, fibrous union, and absorption of the neck are liable to occur. The method of treatment also depends upon the direction of the fracture line. The more transverse type can often successfully be treated by plaster-cast immobilization, while the more vertical type should be treated by internal fixation. This applies particularly to the plane of the fractured surface of the head fragment,—whether a varus or a valgus relationship of the fragments is produced; the valgus position is more favorable for union.

In the diagnosis of union or non-union, unorganized callus is to be distinguished from bony callus by its non-trabeculated structure and by the fact that unorganized callus will not maintain alignment under weight-bearing. The roentgenographic evidences of bony union are as follows: (1) disappearance of the line of fracture, (2) formation of bone trabeculae across the line of fracture and, ultimately, reformation of the "lines of force", (3) maintenance of relative position of the fragments after a trial of weight-bearing, and, occasionally, (4) formation of bony bridges between the fragments outside the boundaries of the neck. Union may occur as early as four months or as late as twenty-four months after fracture.

Non-union is indicated by: (1) persistence of the fracture line (or its reappearance if it has been previously obliterated by impaction); (2) increased density of the fracture surfaces; (3) absorption of a portion of the neck; and (4) lack of maintenance of alignment.

Fibrous union is virtually not diagnosable by roentgenographic examination alone.  
—*Edward N. Reed, M.D., Santa Monica, California.*

ROENTGEN DIAGNOSIS OF HEMANGIOMA OF THE LONG BONES. M. J. Nemenov. *Radiology*, XXXIII, 465, Oct. 1939.

Hemangioma, while it occurs less frequently in bone than in other tissues, was found in the spines of 11 per cent. of 2154 cadavera. The skull is affected next in frequency, while the long bones are rarely involved. Hemangioma is considered a neoplasm, since new blood vessels are formed and surrounding tissues are infiltrated. It is, however, a benign tumor, producing no metastases. It presents a sponge-like structure whose nuclei are lined with endothelium and filled with blood.

Hemangioma of the vertebrae usually causes no symptoms, except when the growth presses upon nerve structures or when the invaded vertebral bodies suffer pathological compression fracture.

In the roentgenograms the affected bodies protrude. The sponge-like structure is changed, and they appear to be covered with longitudinal lines. The vertically lying bone plates are thickened and separated by wide interstices, which admit the passage of the rays more readily.

Hemangioma of bone is often mistaken for malignant tumor. It should be diagnosed by roentgenography. The bone is thickened and appears to have a nuclear structure, but hardly ever is the periosteum impaired, the epiphyseal cartilage invaded, or the surrounding tissues involved. Hemangioma may resemble giant-cell tumor or echinococcus cyst; however, the larger nuclei are penetrated with a fine, looped network of osseous substance. Also, in a giant-cell tumor the bone appears to be inflated and always has a cortical layer, while in a hemangioma the nuclei reach as far as the periosteum.—

*Edward N. Reed, M.D., Santa Monica, California.*

THE RADIOLOGICAL EVIDENCE OF MALIGNANCY IN BONE TUMORS, AND ITS RELATION TO BIOPSY. James F. Brailsford. *Radiology*, XXXIII, 476, Oct. 1939.

To determine the nature of a bone tumor the three lines of investigation commonly employed are: (1) observation of the development of the lesion; (2) biopsy; and (3) roentgenography. If the roentgenographic appearances are those of malignant disease, radical surgical measures should promptly be adopted, even though the clinical signs and symptoms seem insignificant. The insidious development of a lesion in a bone of an individual previously in apparent good health should be regarded as a very suspicious indication of neoplasm. If the history suggests the possibility of an inflammatory lesion, this must first be excluded. By a study of serial roentgenograms alone the nature of the tumor may ultimately be determined.

Histological study provides a much higher percentage of accurate diagnosis than clinical examination alone. Unfortunately, however, biopsy may not only yield material which permits error in interpretation, but may cause local or general dissemination of tumor cells.

Roentgenography permits ready diagnosis of a large proportion of simple and malignant tumors. In those cases in which the roentgenographic evidence is equivocal, the histological features are also likely to be indeterminate. A complete roentgenographic record should be made before any treatment, particularly irradiation, which may cause the most pernicious lesion to appear innocent.

If the roentgenographic evidence suggests a simple and operable lesion, surgical eradication should be done, since benign lesions may undergo malignant metaplasia. The tissue should be examined, and, if the histology suggests malignancy, though the roentgenogram indicates benignancy, watch should be kept for further evidence. Immediate amputation is unlikely to increase the patient's chances and may be unnecessary.

When, according to roentgenographic examination, a lesion is malignant and is operable, amputation should be done at once, as providing the best chance of cure. When a lesion is inoperable, whether it is benign or malignant, radiotherapy should be tried. When a lesion is roentgenographically atypical, it should be immobilized and studied by serial roentgenograms, and routine laboratory examinations should be made. If a



lesion continues to extend, roentgenograms of chest and pelvis should be taken; if these are negative, irradiation should be tried. If this proves unsuccessful, resection or amputation should be done and the material should be studied. Since only a small proportion of bone tumors respond to irradiation, and since this type of therapy is slower and less certain than amputation, it should be reserved for inoperable and doubtful cases. Radium and roentgen-ray irradiation do not prevent the dissemination of metastases even though the primary tumor has responded so favorably that the bone has recovered practically its normal appearance. It is impossible to judge the malignancy of a bone tumor by clinical examination at a stage when operative treatment is of any avail.—*Edward N. Reed, M.D., Santa Monica, California.*

CANCER ET BLESSURES DE GUERRE (SARCOMA DU CREUX POPLITÉ VINGT ET UN ANS APRÈS UNE BLESSURE DE GUERRE). [Cancer and War Wounds (Sarcoma of the Popliteal Space Twenty-One Years after a War Wound).] R. Desjacques. *Revue de Chirurgie*, LVIII, 373, 1939.

The author reports a case of sarcoma of the popliteal space, which developed twenty-one years after a wound in this area, in which a small fragment of needle had been left. The author states that the patient had had no difficulty in the meantime and had forgotten the existence of the wound until a tumor developed. There had been no sinus. This tumor was diagnosed as a polymorphous sarcoma. The thigh was amputated in the middle third, but the patient died of metastasis about one year later. The author believes that as more men who were in the War reach the cancer age there will be more such tumors.—*J. Albert Key, M.D., St. Louis, Missouri.*

FRACTURE DE LA COLONNE LOMBAIRE AVEC PARALYSIE DE LA JAMBE GAUCHE RÉDUITE PAR LA MÉTHODE BÖHLER (Fracture of the Lumbar Spine with Paralysis of the Left Limb Reduced by Böhler's Method). E. Ducrey. *Revue de Chirurgie*, LVIII, 378, 1939.

This is the report of a case in which the patient suffered a compression fracture of the lumbar spine with paralysis of the left lower extremity. The fracture was reduced by hyperextension, and the paralysis cleared up within a few days. A year later the patient was the champion skater of France.—*J. Albert Key, M.D., St. Louis, Missouri.*

XANTHOMATOSE OSSEUSE GÉNÉRALISÉE (Generalized Xanthomatosis of the Skeleton). State Draganescu et S. Tzovaru. *Revue de Chirurgie*, LVIII, 448, 1939.

The authors report the case of a boy, sixteen years of age, who entered the hospital complaining of marked disability, with flexion contractures of the extremities and pain on movement. Roentgenograms of the shoulders, the knees, and the hips showed rarefied areas in the bone. There were also some tumefactions, which were fluctuant. Aspiration of these showed crystals of cholesterol material in the fluid, and biopsy revealed reticulo-endothelial cells filled with vacuoles. Chemical studies of the blood are also reported. The authors point out that this condition is very rare, and that it is different from Schüller-Christian disease in that there is no involvement of the cranium, no exophthalmus, and no diabetes insipidus. Their patient had a paralysis of one side of the face, which was believed to be due to a xanthomatous tumor at the base of the skull. —*J. Albert Key, M.D., St. Louis, Missouri.*

CONTRIBUTION À L'ÉTUDE DE L'OSTÉOMYÉLITE AIGÜE DE LA HANCHE (Contribution to the Study of Acute Osteomyelitis of the Hip). F. Demelenne. *Revue de Chirurgie*, LVIII, 547, Oct. 1939.

In the past seventeen years there have been thirty-three cases of acute osteomyelitis of the hip in the Clinic at Liège. Of these, sixteen were due to the staphylococcus; three were caused by the streptococcus; four were due to the gonococcus; and in six there was no growth on culture. In four cases the germ was not identified. There were twenty-

one acute purulent arthritic hips. Traumatism was noted in only three cases. Most of these cases were treated by incision and drainage with immobilization of the extremity in traction. Among these twenty-one patients, there were four deaths, giving a mortality of 19 per cent. The author has reviewed all of the cases save one, and each of the patients is now carrying on a practically normal life. Two have limited movement and five have ankylosis in flexion, abduction, and external rotation. If one can speak of healing in an affection such as osteomyelitis, complete healing has occurred in nine, or 42.8 per cent. of the cases, while functional healing has taken place in eleven, or 52.4 per cent., and healing in relatively bad position in five, or 23.8 per cent.—*J. Albert Key, M.D., St. Louis, Missouri.*

L'AVENIR DE LA CHIRURGIE DU GENOU MOU (The Future of Surgery of the Soft Parts of the Knee). Arnold Jirasek. *Revue d'Orthopédie et de Chirurgie de l'Appareil Moteur*, XXVI, 98, 1939.

The author analyzes the problems connected with post-traumatic afflictions of the periarticular and intra-articular structures of the knee joint. Basing his study on 511 patients operated upon by him, and on recent contributions in the field of anatomy, histology, and function of the knee, he calls attention to certain parts of the complex apparatus of the knee joint. The causes and the course of the early and persistent atrophy of the quadriceps femoris are considered in the light of the new investigations. The mobile meniscus and the all-important question of the intra-articular fat pad and the periarticular fat, as well as other important phases of the post-traumatic disabilities, are discussed. The proper placing of surgical incisions is dealt with in detail. The purpose of the article is to indicate the important lines of investigation for the future improvement of technique and the further development of the surgery of the knee joint.—*Emanuel B. Kaplan, M.D., New York, N. Y.*

LUXATIONS HABITUELLES DE LA ROTULE (Habitual Dislocations of the Patella). F. E. Godoy Moreira. *Revue d'Orthopédie et de Chirurgie de l'Appareil Moteur*, XXVI, 202, 1939.

The author gives a general survey of the problem of habitual dislocations of the patella. He mentions that Marziani has gathered from the literature sixty different surgical procedures for the treatment of this affliction. As early as 1850 Heller proposed the use of sclerosing injections into the medial part of the capsule of the knee, and Fowler in 1891 proposed the extirpation of the patella.

The author describes three cases in which three different methods were used with success. In the first case, the Ali Krogus procedure, as modified by Lecène and Moulon-guet, was employed. This consists in passing the capsulo-aponeurotic flap through the tendon of the quadriceps femoris, which is split in the frontal plane. In the second case, the technique of Roux, consisting in the transposition of the anterior tuberosity of the tibia medialward, was used. In the third case, the same technique, as modified by Mouchet, was followed.

The author states that the method of operation is dictated by the particular character of each individual case; no one method should be used universally. He believes that the following points should be taken into consideration in deciding the operative procedure: (1) obliquity of the extensor apparatus; (2) atrophy of the lateral condyle; (3) genu valgum deformity; and (4) laxity of the capsule.—*Emanuel B. Kaplan, M.D., New York, N. Y.*

PŘÍSPĚVEK K DIAGNOSTICE A LÉČENÍ VERTEBRA PLANA CALVÉ (Contribution to the Diagnosis and Treatment of Calvé's Vertebra Plana). R. Pavlanský. *Slovanský Sborník Ortopedický*, XIII, 191, 1938.

The author describes the case of a girl of seven, who presented herself, complaining of pain in the thoracic spine. This pain gradually became worse and was exacerbated by

rapid walking. The patient tired easily and lost her appetite. Examination disclosed a slight kyphosis in the region of the seventh thoracic vertebra. The spinal muscles were spastic. Forward bending increased the pain, but pressure over the head seemed to have no effect on the pain. A tentative diagnosis of tuberculous spondylitis was made. Roentgenographic examination disclosed flattening of the seventh thoracic vertebra, without any bone destruction, and an increase in the thickness of the intervertebral disc.

The patient was kept recumbent on a hyperextension plaster shell for a period of eight months. Thereafter she was fitted with a plaster cast and later with a leather corset. Subsequent studies showed an almost complete restoration to normal.

In his discussion of vertebra plana, the author calls attention to the fact that of the two cases first reported by Calvé, one was a case treated by Brackett, of Boston. The disease occurs mainly between the ages of four and seven and is twice as common in boys as in girls. Clinically, the symptoms resemble those of tuberculosis. Pain, tenderness, muscle spasticity, and, later, gibbus formation develop. Usually only one vertebra is involved. By the time the patient presents himself for examination, roentgenographic signs are evident.

In the early stage, decalcification of the vertebra, proceeding toward the center of the body of the cartilage plates, occurs. In the florid stage, collapse of the vertebra takes place. Wedging does not occur, and the epiphyseal plates approach one another in an almost parallel direction. At the same time the adjacent intervertebral discs increase in height, in proportion to the collapse of the body. In the third stage, recalcification of the body takes place, proceeding from the center toward the epiphyseal plates. This recalcification may be intermittent and seldom results in complete restitution of the normal thickness of the vertebral body. In youthful patients, healing usually occurs within from eighteen to twenty-four months. In older patients, healing may be longer delayed, although the prognosis is invariably good.

Vertebra plana must be differentiated from tuberculosis and occasionally from sarcoma of the vertebra. The author reports a case of sarcoma which closely resembled vertebra plana in its early stages. Later, however, destruction of the posterior neural arch suggested the malignant nature of the affection. Death supervened, but an autopsy was not obtained.—*Henry Milch, M.D., New York, N. Y.*

ACETABULOPLASTY FOR DISLOCATION OF THE HIP. I. William Nachlas. *Southern Medical Journal*, XXXII, 565, 1939.

Various types of "shelf" operations are mentioned; the difficulties encountered in the usual operative techniques are described; and the characteristics of a satisfactory shelf are enumerated. The author then gives a detailed description of his method for improving the size and shape of the acetabulum in those cases of dislocation of the hip in which the head of the femur can be replaced in the socket. This operation is used for congenital dislocations, paralytic dislocations, or for distorted acetabula following disease or degenerative changes. Eight cases are reported. In each case a stable, weight-bearing, painless hip was obtained.—*Fred G. Hodgson, M.D., Atlanta, Georgia.*

CYSTS OF THE SEMILUNAR CARTILAGES. I. S. McReynolds. *Southern Medical Journal*, XXXII, 571, 1939.

The author discusses the etiology and states that mucoid degeneration and trauma are probably factors. These cysts are considered to be congenital by some authors. The lateral third of the external cartilage is chiefly involved. The majority of the cases occur in males. The symptoms are moderate pain and swelling about the joint and tenderness on deep pressure. The main points in the diagnosis are the location of the mass on the level of the joint and its movement with the tibia on motion in the joint. The pathology of the condition is described and well illustrated. The treatment is complete extirpation of the cyst with removal of the entire affected cartilage. Recurrence takes place if the

entire cartilage is not removed. Aspiration may give relief for a short time. Over 257 cases have been reported.—*Fred G. Hodgson, M.D., Atlanta, Georgia.*

TREATING FRACTURES BY SKELETAL FIXATION OF THE INDIVIDUAL BONE. H. H. Haynes. *Southern Medical Journal*, XXXII, 720, 1939.

Multiple pins or half pins are used for this purpose. These pins are connected by rigid supports, held in a definite relation to each other by a connection that is strong, light, and adjustable. The author uses blocks and yokes, which are held firmly by telescoping bars with split-sleeve adjustment. Steinmann pins or threaded half pins are used. For the proper introduction of the latter, open operation is often required. The reduction is always checked by fluoroscope or roentgenograms. The joints above and below the immobilized bone are freely movable. The patients are immediately ambulatory. Better circulation and nutrition are maintained, and the author feels that earlier callus formation and healing may be expected.—*Fred G. Hodgson, M.D., Atlanta, Georgia.*

CONTROVERSIAL QUESTIONS IN THE MANAGEMENT OF FRACTURES. Isidore Cohn. *Southern Medical Journal*, XXXII, 879, 1939.

This is a general consideration of the management of fractures, written by a man of large experience. It should be read by all those interested in this subject, especially by men in charge of fracture services in hospitals. The author suggests: (1) better and more extensive training in the medical schools; and (2) closer supervision on the part of the staff in the large hospitals. He feels that early proper management will diminish the need of spectacular operations at a later date.—*Fred G. Hodgson, M.D., Atlanta, Georgia.*

COMPOUND FRACTURES AND THEIR TREATMENT. Austin T. Moore and James T. Green. *Southern Medical Journal*, XXXII, 891, Sept. 1939.

Directions for first-aid treatment and for the treatment of shock are given. Prophylactic measures against tetanus and gas infection should be repeated in suspected cases. Local care of the wound should be undertaken in the operating room and under anaesthesia. Mechanical cleansing is preferable to the use of antiseptics. The authors frequently use gallons of water and spend twenty minutes or more in cleansing the wound. This should be done at the earliest possible moment, for infection may be well under way within six hours. All dead and devitalized tissue should be removed, but loose fragments of bone should be preserved whenever possible. Extreme gentleness should be exercised at all times. The wound should be closed loosely and the limb should be elevated and adequately immobilized in a position of physiological rest. The use of internal fixation of the bone ends should be avoided when possible. If fixation is required, the authors advocate a small wire, a screw, a bolt, or a projecting pin or screw. They believe that skeletal traction or a Steinmann pin above and below the fracture is often useful. If danger of infection is not too great, the wound should be closed, especially over the shin bone.—*Fred G. Hodgson, M.D., Atlanta, Georgia.*

TREATMENT OF SCOLIOSIS WITH BONE TRACTION. Frank Goodwin and D. K. Barnes. *Southwestern Medicine*, XXIII, 208, 1939.

The author presents an ingenious new technique for the correction of scoliosis.

The first step is a thorough roentgenographic study of the patient's curve to determine how high and how low the ultimate fusion may have to be carried. Next a plaster cast, incorporating anterior and posterior hinges in the usual way, is applied. Correction is then carried out by wedging the cast until the maximum amount of correction has been obtained. Additional plaster is applied to hold this correction. A special

apparatus called a "pusher" is then incorporated in the plaster on the side of the convexity. A window is cut out over the vertebrae to be fused. The exact vertebrae to be fused are located, and a Hibbs fusion carried out. It is usually necessary to remove additional bone for grafts from the tibia. The spinous processes of the three vertebrae forming the apex of the curve are carefully preserved. A groove is made around the bases of these spinous processes, and pliable stainless-steel, 20-gauge wire is looped over them. An aneurysm needle is passed through the skin and the musculature on the side of the back in the posterior axillary line and forced toward the open incision. The wire is threaded in the needle and pulled back through the muscle and skin and through a hole in the cast. All three of the wire loops are then attached to an apparatus that will enable traction to be placed on them. The wires are tightened daily until complete correction has been obtained. Usually in three weeks the maximum possible correction is obtained. These wires remain in place until firm bony ankylosis occurs. The plaster cast is retained for three months following the last operation, and the patient is then supported by corsets for twelve additional months. Children of twelve years and over may be treated by this method, but younger patients have incomplete ossification of the spinous processes and are not, therefore, suitable subjects.

Six cases in which this method was used are presented and in each case greater correction than is often possible with the standard technique was obtained. In no case did there develop any infection, pain about the wires, or neurological symptoms, and in no case was the rotation increased.—*Herbert E. Hipps, M.D., Marlin, Texas.*

**BRACHIAL BLOCK ANESTHESIA.** Charles H. Arnold and L. A. Gibson. *Southwestern Medicine*, XXIII, 249, 1939.

Brachial-block anaesthesia is a valuable procedure yet it is rarely used. The technique is simple. With the patient sitting or in a semi-reclining position, a needle is inserted at the mid-point of the clavicle, just over the clavicle and toward the transverse process of the seventh cervical vertebra. The point of the needle will rest on the outer surface of the first rib or on the plexus. From thirty to forty cubic centimeters of 2-per-cent. novocain is injected, and within twenty minutes the arm is anaesthetized.

Two precautionary measures are important: the needle should not rest in the lumen of a large blood vessel, and the point of the needle should never pass beyond the first rib, to avoid puncturing the pleura.—*Herbert E. Hipps, M.D., Marlin, Texas.*

**CONGENITAL BOWING AND PSEUDARTHROSIS OF THE LOWER LEG. MANIFESTATIONS OF VON RECKLINGHAUSEN'S NEUROFIBROMATOSIS.** C. Glenn Barber. *Surgery, Gynecology and Obstetrics*, LXIX, 618, Nov. 1939.

The writer conclusively shows for the first time in American literature the close relationship between congenital bowing of the lower leg, pseudarthrosis, and von Recklinghausen's disease. The congenital and hereditary nature of the condition is noted. The fact is stressed that any operative procedure such as osteotomy, osteoclasis, or accidental fracture will be followed by pseudarthrosis, which does not respond to bone-grafting. The author reports five cases in addition to a brief review of eleven cases of the French observer, Robert Ducroquet. The article is excellently illustrated.—*Richard McGowney, M.D., Santa Barbara, California.*

**MULTIPLE MYELOMA.** Ralph K. Ghormley and George A. Pollock. *Surgery, Gynecology and Obstetrics*, LXIX, 648, Nov. 1939.

The authors introduce their discussion of multiple myelomata with an interesting historical note on the discovery of the lesion and its connection with the excretion of Bence-Jones bodies in the urine. The etiology of the disease is not known. There is no curative treatment. Early recognition of the disease is important, because it per-

mits a prognosis. There are no pathognomonic symptoms. The first complaint is usually backache in a person of middle age. Tumefaction and neurological signs are rare. Roentgenograms may show small punched-out areas in the pelvis, the skull, the ribs, or the femur. In the early stages the disease may only be suspected, and a reexamination is indicated in from three to four months. In many cases the final diagnosis can be made only by biopsy.

The writers have studied eighty-six cases seen at The Mayo Clinic. The average duration of the disease was twenty-six and nine-tenths months. It occurred twice as frequently in males as in females. Laboratory tests were not done consistently enough to draw conclusions of value. Bence-Jones protein was found in 51 per cent. of the patients. Renal damage was observed in 61 per cent. and suspected in all before death.

As to the prognosis, all patients with bone involvement die from the disease. There may be temporary improvement with or without treatment. Roentgen-ray treatment may temporarily relieve symptoms, but it is doubtful that it prolongs life.—*Richard McGovney, M.D., Santa Barbara, California.*

BEHANDLUNGSERGEBNISSE DER OPERIERTEN MENISKUSVERLETZUNGEN (The Results of Operative Treatment of Injuries to the Meniscus). Lorenz Böhler. *Wiener klinische Wochenschrift*, LI, 1166, 1938.

This statistical study of the results of resection of the meniscus shows that in the 300 cases in which operations were performed there were 263 medial resections and thirty-seven lateral resections. The ages of the patients ranged from sixteen to fifty-five years.

The types of injury were as follows:

115 bucket-handle fractures

35 longitudinal tears, extending from the anterior horn to the posterior horn

10 longitudinal tears in the anterior third

31 longitudinal tears in the middle third

20 longitudinal tears in the posterior third

42 pedunculated tears

57 transverse and longitudinal tears in different locations.

In evaluating the end results, patients with absolutely normal knees were rated as having excellent results, and patients with a functional range of 180 to 70 degrees, with no instability and good musculature, were classified as having good results.

In the first series of 111 cases, excellent results were obtained in 84 per cent. and good results in 16 per cent. The second series consisted of fifty-one cases, and the results were excellent in 92 per cent. and good in 8 per cent. In the fifty-nine cases of the third series, excellent results were secured in 75 per cent. and good results in 25 per cent. The author concludes that the results indicate that the present method of treatment is adequate and proper.—*J. D. Stewart, M.D., Iowa City, Iowa.*

DIE ERGEBNISSE SEITLICH-HINTERER KNIEGELENKSERÖFFNUNG WEGEN MENISKUSVERLETZUNG ODER CORPUS LIBERUM (Results of Lateral Posterior Incisions in Meniscus Lesions or in Loose Bodies in Knee Joints). Fritz Felsenreich. *Zentralblatt für Chirurgie*, LXVI, 2008, 1939.

This method has been followed in thirty-two out of seventy meniscus operations. In the opinion of the author, lesions of the posterior portion of the meniscus are more common than is generally believed. In all such cases his method is indicated. He also recommends it for cases in which radical extirpation of the anterior portion of the meniscus is difficult, and for transverse tears around the lateral ligament, usually associated with severe changes in the posterior portion of the meniscus.—*Ernest H. Bettmann, M.D., White Plains, New York.*

# The Journal of Bone and Joint Surgery

## THE RESTORATION OF PHYSIOLOGICAL AND ANATOMICAL FUNCTION IN OLD UNUNITED INTRACAPSULAR FRACTURES OF THE NECK OF THE FEMUR \*

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*From the Division of Orthopaedic Surgery, Department of Surgery, University of Chicago*

Varied and multiple are the procedures which have been proposed for the treatment of old ununited fractures of the intracapsular neck of the femur. The most widely used, until comparatively recent years, was the reconstruction operation proposed by Royal Whitman<sup>20</sup>. Although modified by Albee<sup>2</sup>, Colonna<sup>6</sup>, and Campbell<sup>5</sup>, this operation resulted all too frequently in an unstable hip, inability to control the pelvis because of the shortened or absent femoral neck, and, not infrequently, *pain* upon motion or weight-bearing. (See Figure 1.)

Brackett<sup>3</sup> described an operation which increased the incidence of union between the greater trochanter or remaining portion of the femoral neck and an articular cap of the hollowed-out head of the femur. Luck<sup>12</sup> proposed an additional variation in technique for utilizing the femoral head. (See Figure 2.) Campbell<sup>4</sup>, Henderson<sup>9</sup>, Albee<sup>1</sup>, Jones<sup>10</sup>, and others have reported the successful utilization of full-thickness tibial, fibular, or femoral bone grafts in promoting osteogenesis and union of old ununited fractures of the femoral neck. (See Figure 3.) Gill<sup>8</sup> believes that arthrodesis is indicated in some cases of ununited fracture of the neck of the femur.

As somewhat simpler procedures, which in a surprising number of cases were followed by union of the fracture, Schanz<sup>16</sup> advocated the low osteotomy and Putti<sup>15</sup>, among others, favored osteotomy just above the level of the lesser trochanter with medial displacement of the distal fragment to a position subtending the fracture line. These two procedures are not extensive, and operative shock is minimal.

\* Read at the Annual Meeting of the American Academy of Orthopaedic Surgeons, Boston, Massachusetts, on January 25, 1940.

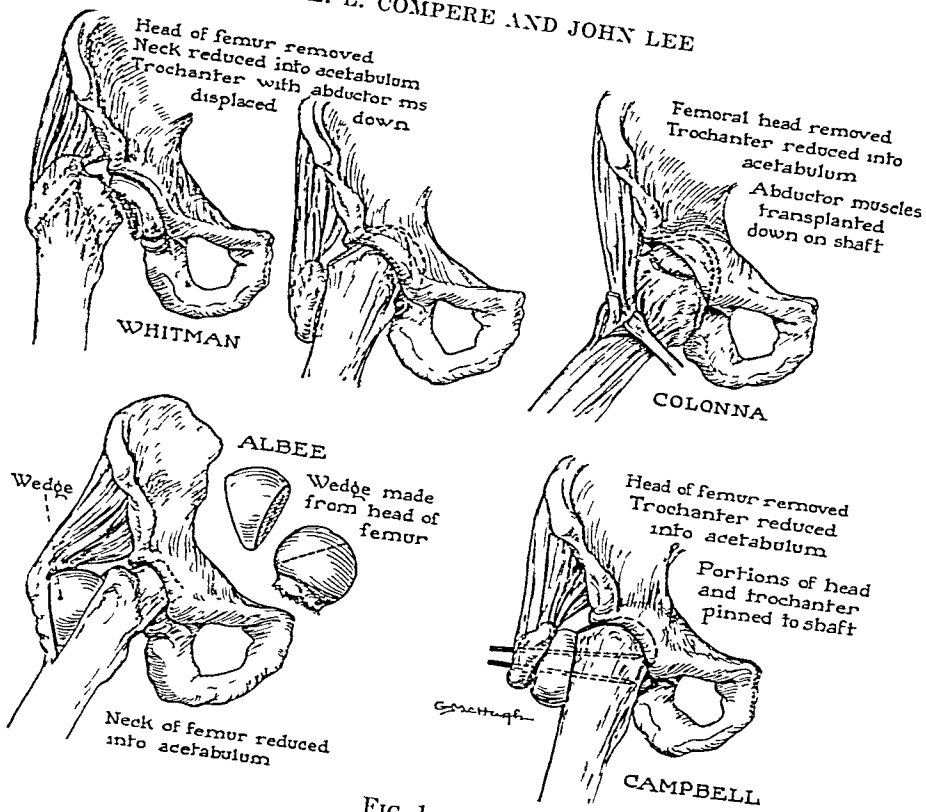


FIG. 1

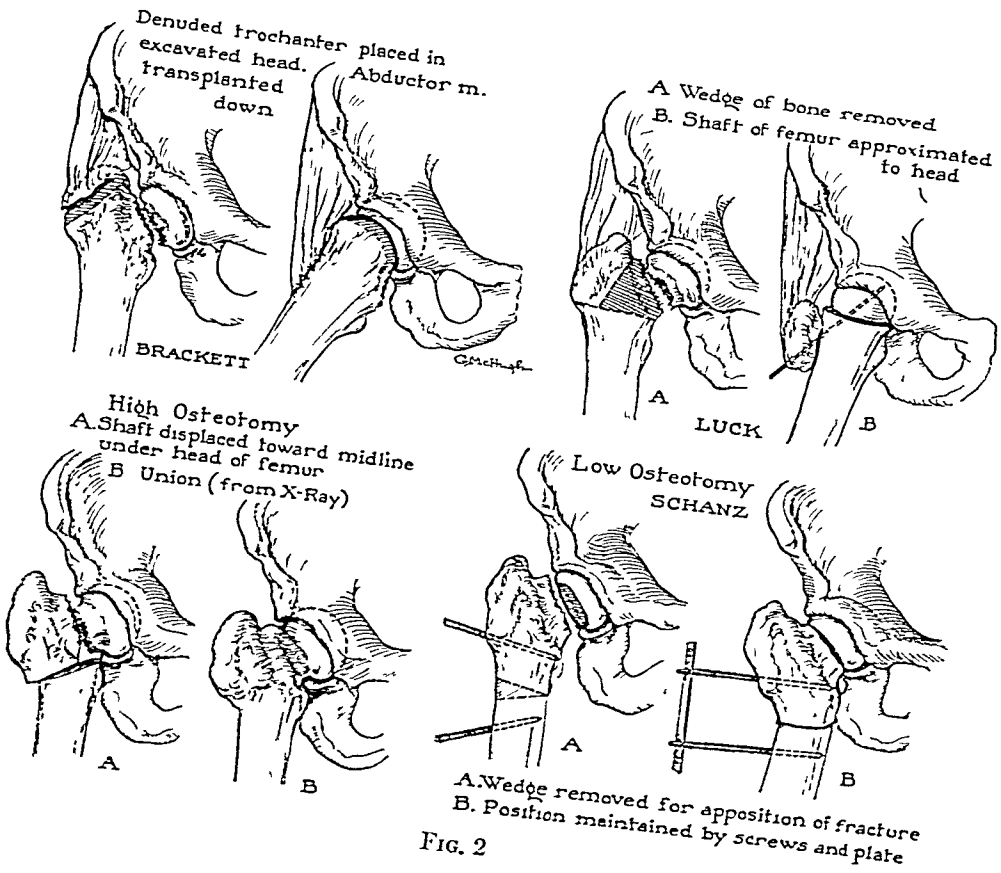


FIG. 2



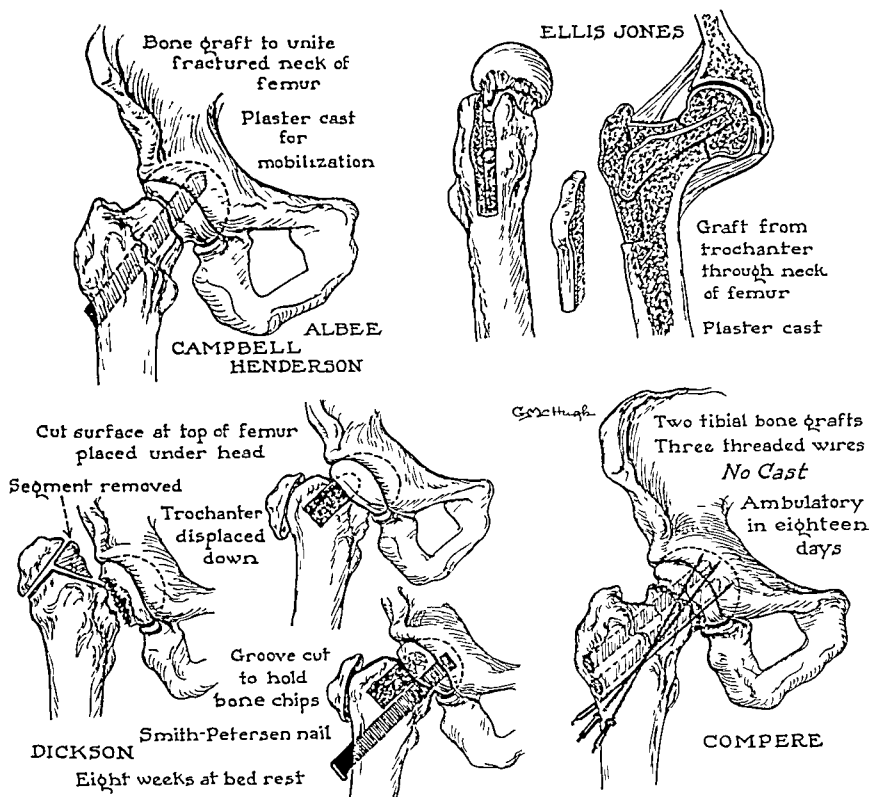
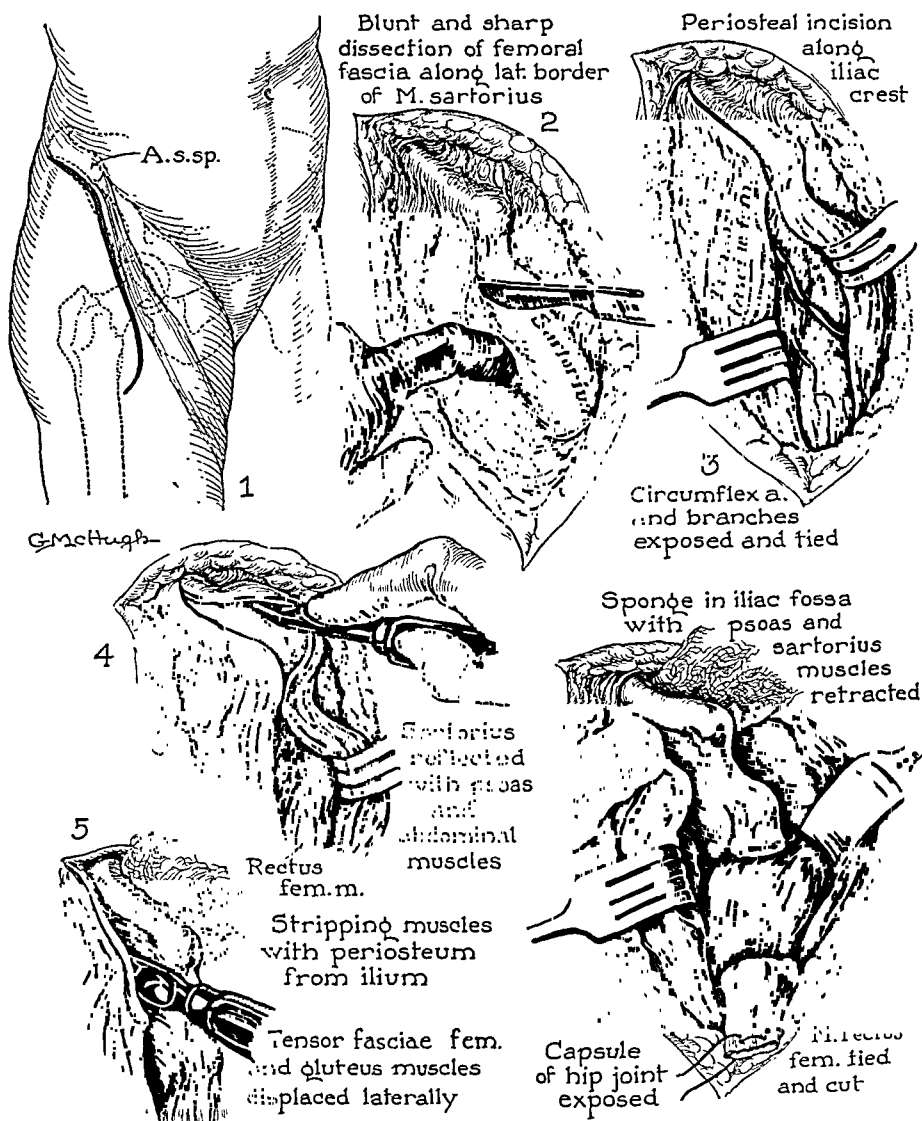


FIG. 3

All of these operative procedures require the reapplication of body and leg casts for periods of time varying from a few weeks to four or five months. Although healing of the fracture of the neck of the femur may result from any one of several of these procedures, reimmobilization with a protracted period of recumbency may be regarded as an ill-advised or dangerous procedure. Knee joints in which motion has already been decreased, because of the first immobilization, may suffer irreparable injury from this second period of plaster-cast therapy.

Thirty-five patients with old ununited intracapsular fractures of the neck of the femur have been admitted to the University of Chicago Clinics during the past twelve years. In three of these, non-union followed treatment by Whitman abduction casts on our own Hospital Service. Treatment of the thirty-two who received their initial care elsewhere had consisted of Whitman abduction casts, traction, sandbags, or merely rest in bed. In the University of Chicago Clinics, treatment of the old ununited fractures varied. Until three years ago the procedures which we used included the Whitman reconstruction operation, the Brackett operation, insertion of a tibial bone graft, and arthrodesis. Functional results which were obtained were not encouraging. During the years 1934 to 1936, two tibial bone grafts were used successfully in each of three successive cases. Each of these patients, however, subsequently



MODIFIED SMITH-PETERSEN APPROACH

FIG. 4

suffered from a painful knee with decrease in the range of knee motion. In spite of this, until 1937, they represented our most satisfactory end results.

The cost of a second period of immobilization and hospitalization for not less than three and, in some instances, as long as six months was an additional contra-indication to the operation for open reduction, insertion of an autogenous bone graft, and plaster-cast immobilization. For most patients who were in need of the care which we wished to recommend, the economic hurdle was insurmountable. In a teaching institution, where both the resources and the number of beds are limited, we could not justify this use of one of our few endowed beds for so long a period of time.

The success of various methods of internal metallic fixation in the

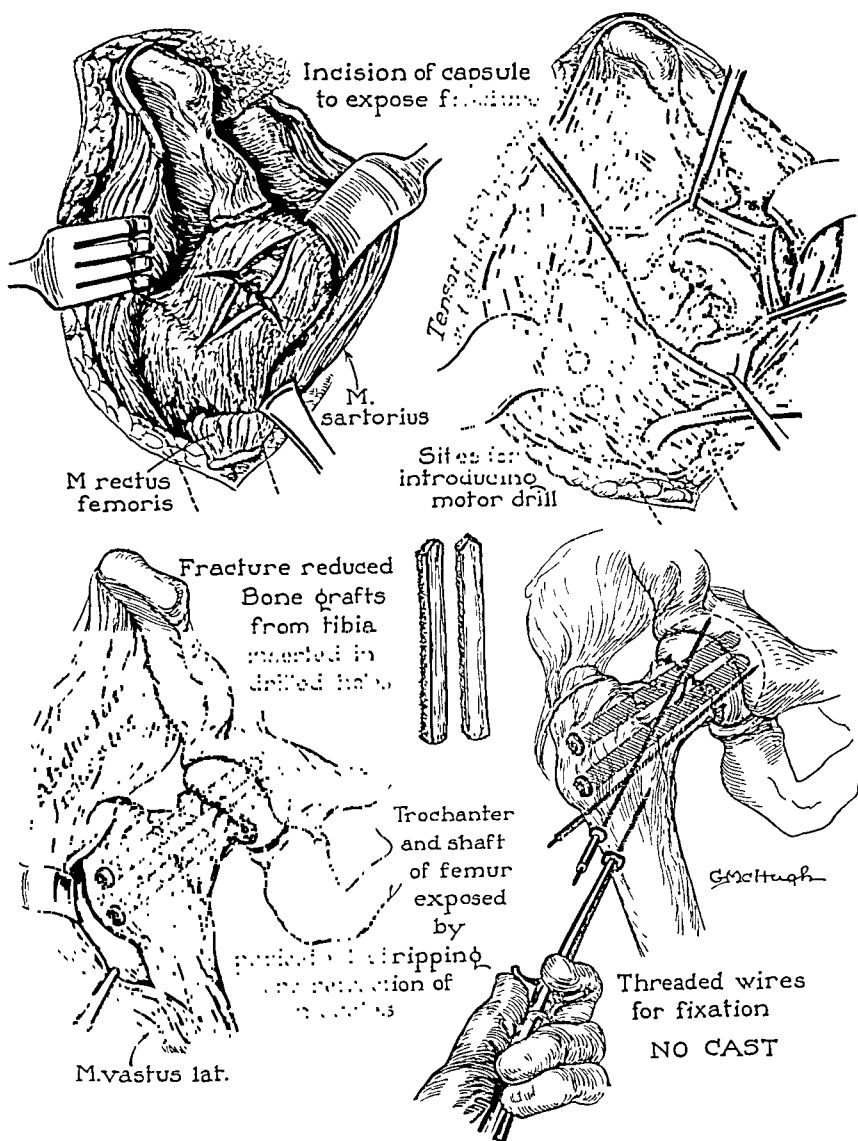


FIG. 5

treatment of fresh fractures of the neck of the femur encouraged us to attempt to combine this principle for immobilization with the bone grafts, as a means of encouraging osteosynthesis.

In a series of recent fractures of the hip, which we had treated with threaded 18-8 \* stainless-steel wires, gauge .080, with 56 threads to the inch, we had obtained effective immobilization and union. No cast was used, and the patients were ambulatory on crutches within a few days after the fracture was reduced.

In the interest of economy and to avoid the dangers of prolonged reimmobilization, we decided to combine this technique with that of

\* 18 per cent. chromium and 8 per cent. nickel.

the autogenous bone graft in the treatment of old ununited femoral-neck fractures. The Smith-Petersen nail<sup>19</sup> was not used, because it is a three-bladed chisel, which might further reduce the already depleted blood supply to the femoral neck or head. In controlled experiments threaded wires were found to hold much more securely than did smooth Kirschner wires, which Selig<sup>17</sup> reported to be unsatisfactory when used in recent fractures of the hip.

The following technique was employed: Under general anaesthesia, with the patient on a fracture table, both feet were placed in the stirrups and moderate traction was applied. A modified Smith-Petersen approach<sup>18</sup> was used (Fig. 4). The fracture line was exposed. The traction was increased until a valgus position between the neck of the femur and the shaft was created. The fibrous union at the site of the fracture was disturbed only in so far as was necessary in order to obtain alignment of the fragments and approximation of the fracture surfaces.

When a satisfactory position of the fragments had been obtained, with as little disturbance of the capsule of the joint as possible, two drill holes, one-half an inch in diameter, were made through the greater trochanter and the femoral neck, across the fracture site, and into the head of the femur. Into each of these a tibial bone graft was driven. The graft was cut so that it would fit snugly, but it was not doweled. By means of a hand drill, three or more threaded wires were then introduced in a manner similar to that described by Moore<sup>13</sup> for the nailing of recent fractures. The wires were permitted to project laterally from the cortex of the femur for about one centimeter, so that it would be possible to remove them after union had occurred, if this became advisable (Fig. 5).

Experimental and clinical studies showed that these threaded wires maintained a firm hold upon the bone, with no absorption about those which were removed after nine months to two years from the date of insertion. It is necessary to use a reverse chuck drill in order to extract them.

The first patient to be operated upon by this method (A. H., female, aged fifty-seven years) came to the University of Chicago Clinics on April 27, 1937, eighteen months after an intracapsular fracture of the neck of the femur in November 1935. Her previous treatment had consisted of closed reduction and a Whitman type of abduction spica cast, which was worn for ten weeks. This period of complete immobilization was followed by months of walking with crutches and finally with a cane.

Examination revealed a transverse fracture with non-union, and the roentgenogram indicated probable necrosis of the head of the femur. In spite of her own disability, she was attempting to keep house for a sister, who was a complete invalid. We could not spare one of our few teaching beds for the number of months which would be necessary if the patient were treated by the method of open reduction, insertion of two tibial bone grafts, and a plaster cast.

Although we did not know of any precedent for such a departure, we decided to use the method of internal fixation described, which we had found successful in the treatment of fresh fractures of the hip, in conjunction with open reduction and the insertion of two autogenous tibial bone grafts.

The operation was performed on May 5, 1937. After an anatomical position had

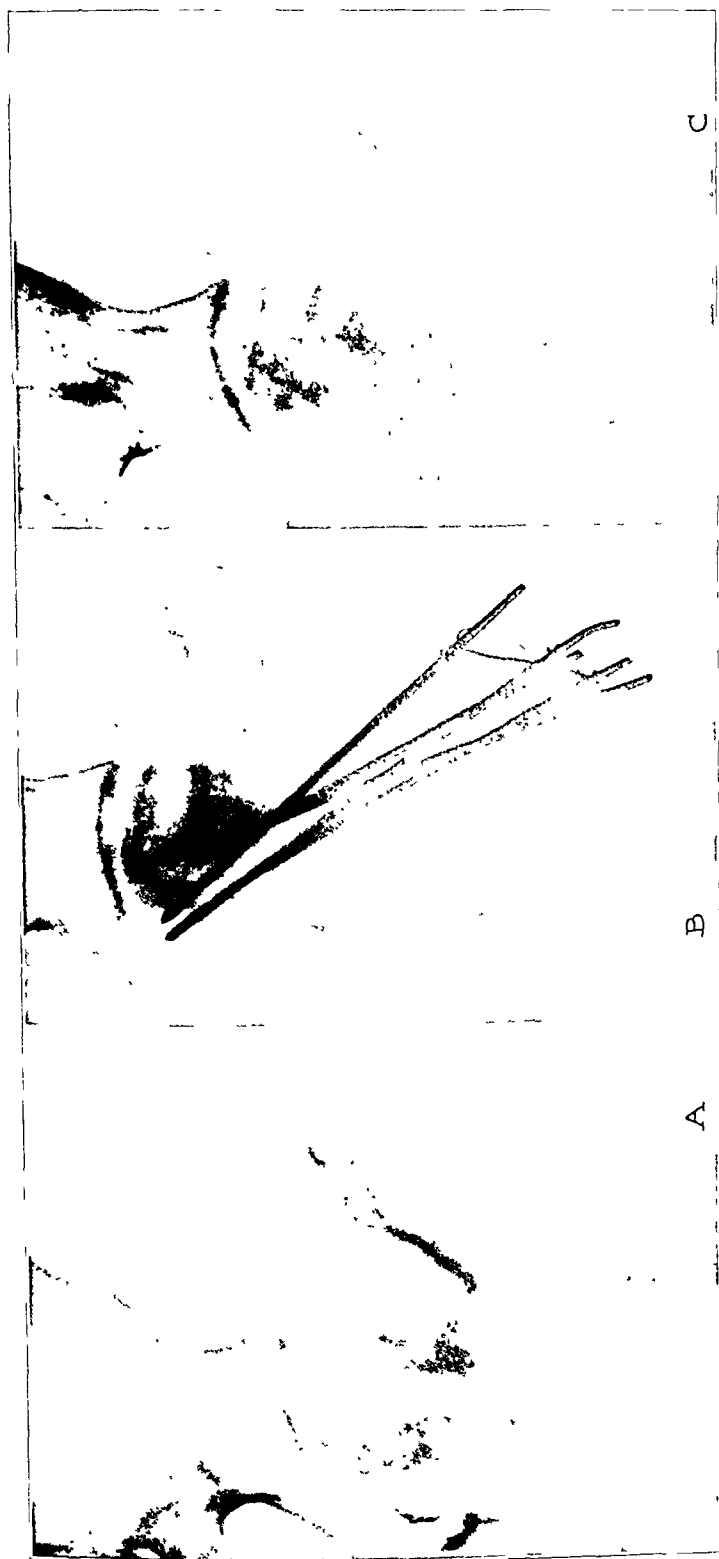


FIG. 6

Case 1. A. H., female aged fifty-seven years.

A: Eighteen months after fracture. The head of the femur has retained its density to a greater extent than have the surrounding osseous structures. There has been considerable absorption of the femoral neck.

B: Twenty-one months after open reduction, insertion of bone graft, and pinning. No cast was applied. Although two of the threaded wires had penetrated the cortex of the femoral head, this patient had an excellent range of painless motion and had been walking without support of crutch or cane for sixteen months.

C: Two years and seven months after operation. The irregular density of the head is shown here more definitely than in the preceding roentgenogram. There is some beginning flattening of the cortex superiorly. In spite of these evidences of aseptic necrosis and replacement by creeping substitution, the function of this hip continues to be excellent.

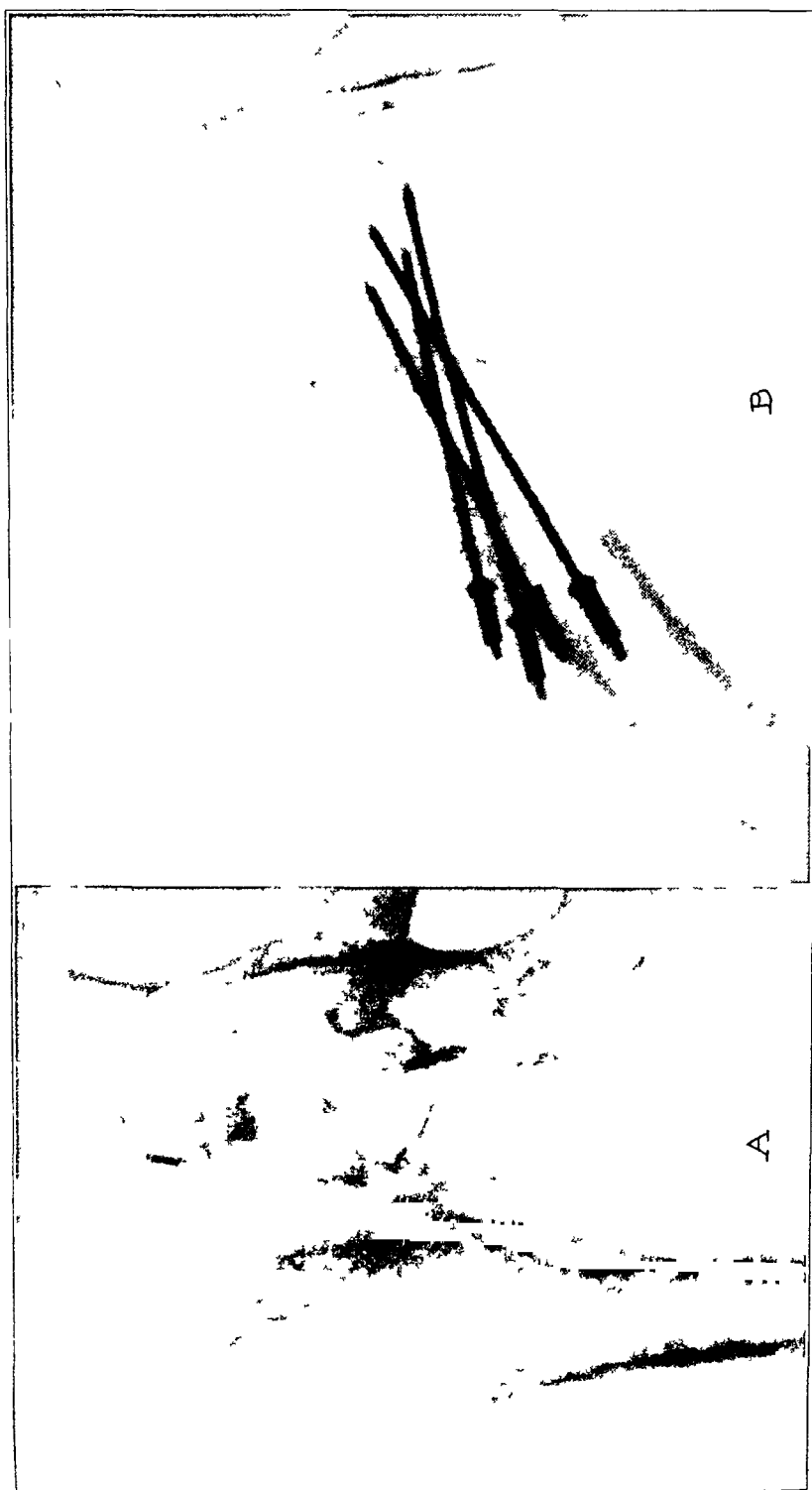


FIG. 7

Case 2. A. Mc., female, aged sixty-two years.

A: Ununited fracture of the neck of the femur of six months' duration. The spotty atrophy of the head is quite similar to that of the region of the greater trochanter, shaft, and pelvis. This head would be considered to be viable.

B: Ten months after open reduction, insertion of two bone grafts, and fixation by four threaded wires. No cast was applied. This lateral roentgenogram shows solid bony union between the live head and the neck of the femur. In this instance, the wires produced no recognizable irritation and were not removed. The range of motion was approximately normal and painless. The patient was able to walk without discomfort.

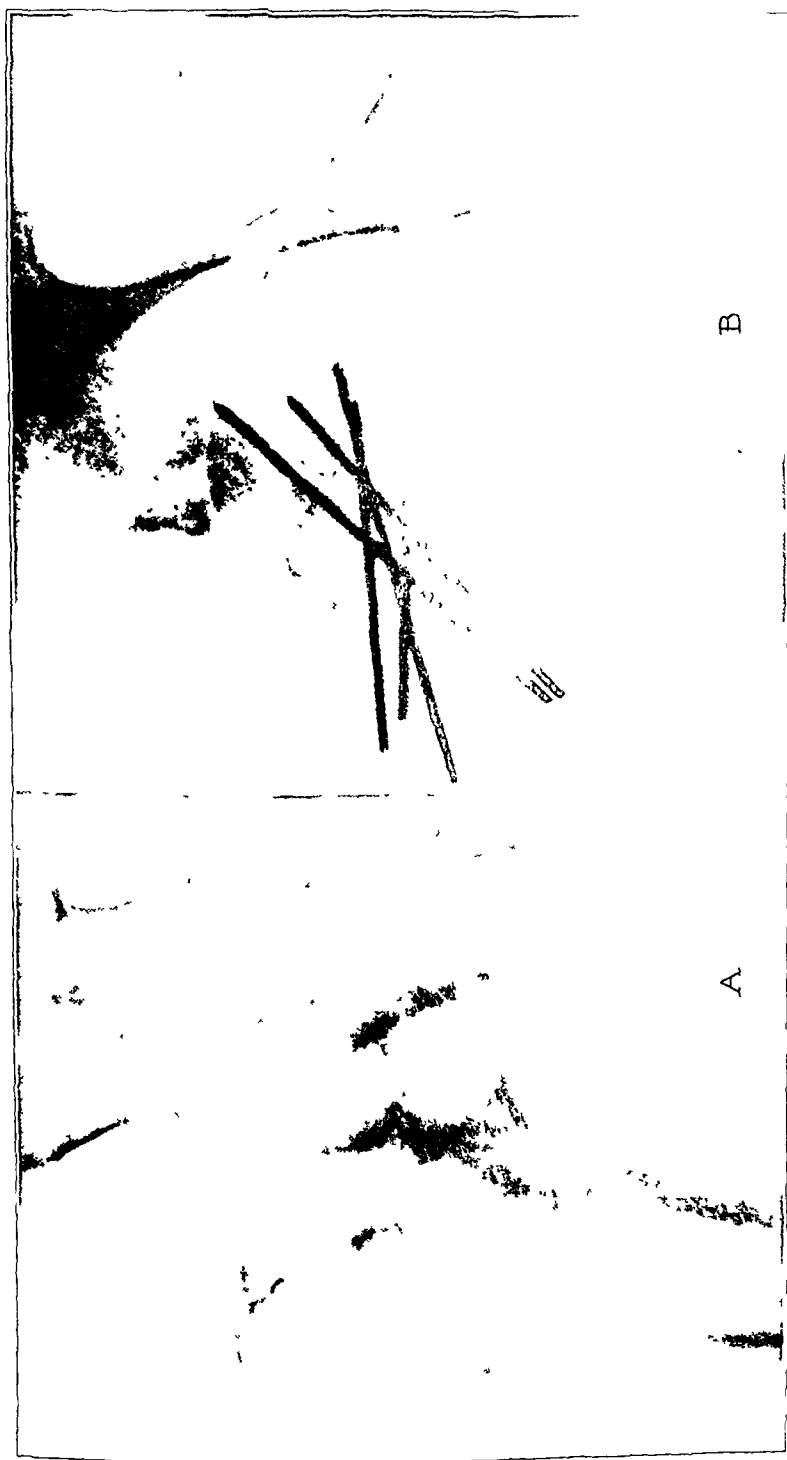


FIG 8

Case 3. H. V., male, aged fifty years  
 after four months and sixteen days.

A: Ununited fracture of the neck of the femur after four months and sixteen days.  
 B: Thirteen months after open reduction, insertion of two tibial bone grafts, and wire fixation. (A short hip spica cast was applied for transportation of the patient to his home in southern Illinois.) Because of the absorption of the neck of the femur, the greater trochanter was detached and shifted downward and pinned in place with two of the threaded wires. Solid bony union occurred. Motion, however, was not as good as in the other cases in this series, because of the fact that this patient was kept in a cast for more than four months before coming to the Clinic. As a result of the long immobilization, he had a painful knee with marked loss of motion, as well as atrophy of bones and muscles.

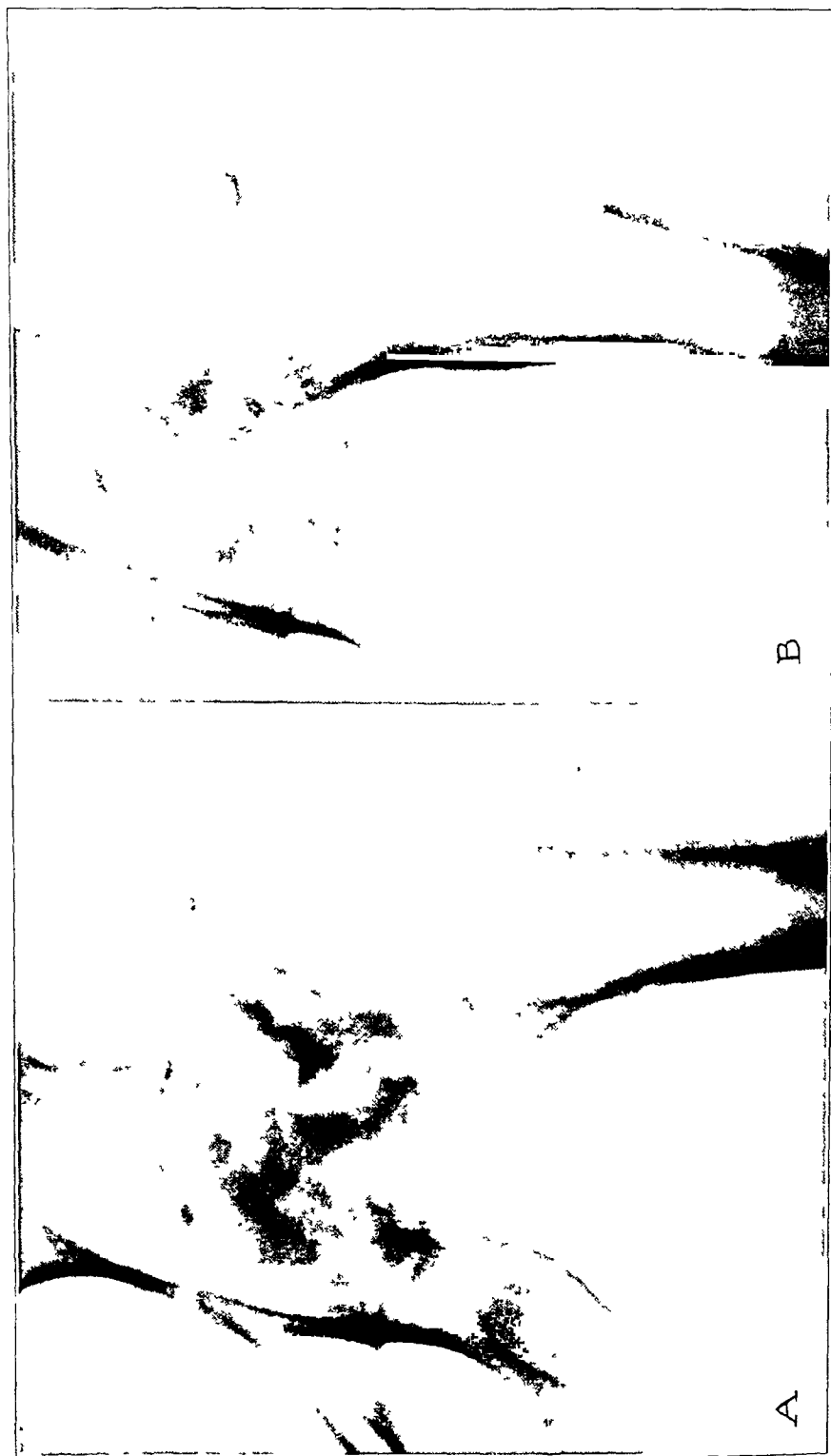


FIG. 9

Case 5 H. A., female, aged fifty-three years.

A. Ununited fracture of the neck of the femur with partial aseptic necrosis of the head, eleven months after fracture.

B. Nine months after open reduction and insertion of two tibial bone grafts and three threaded wires. No cast was applied. Solid bony union occurred, and the wires were removed shortly before this roentgenogram was taken. (Courtesy of Dr. D. B. Flemmster)



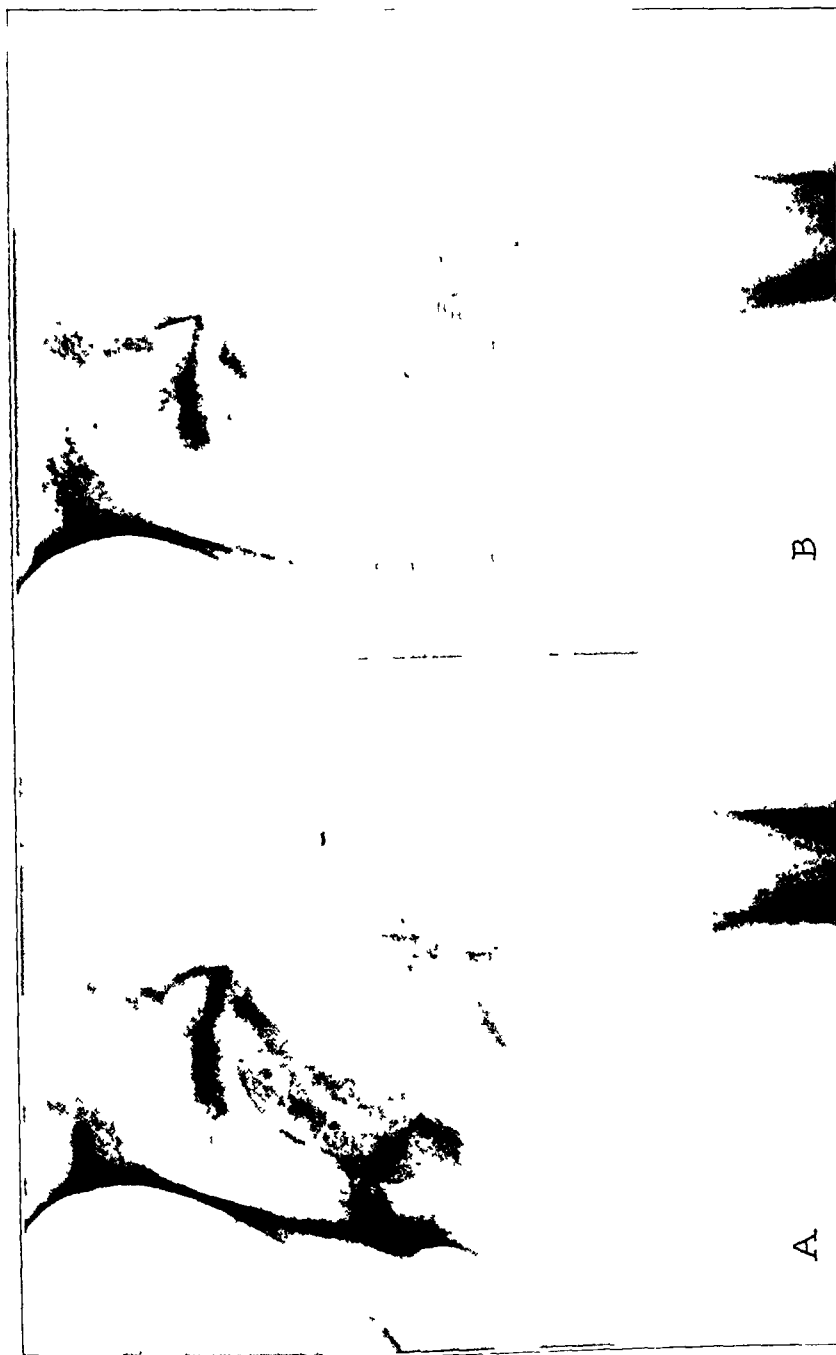


FIG. 10

Case 7. H. C., female, aged forty-six years.  
 A: Fracture of the neck of the femur unreduced and ununited after six weeks' rest in bed.

B: Three months after open reduction and insertion of two tibial bone grafts with threaded-wire fixation. No cast was applied. The wires were removed earlier than in any other case in the series, because one wire penetrated the cortex of the femur, and, while it did not interfere with motion of the hip, it did not seem advisable to permit weight-bearing until it had been withdrawn. Although bony union has occurred, it is not yet solid enough to permit the patient to bear full weight upon this hip. The patient is active on crutches.

been obtained and the two tibial bone grafts had been inserted, five threaded stainless-steel wires were used. No cast was applied. Seven days after operation, on May 12, 1937, the patient was able to sit comfortably in a wheelchair. On May 25, 1937, she began walking with crutches, and was discharged from the hospital on May 31, twenty-six days after operation and thirty-three days after entering the hospital. She returned to her home and resumed her duties as housekeeper for her invalid sister. Position of the reduced fracture of the hip was maintained. Solid union occurred in spite of the fact that the head of this femur, as judged by gross and roentgenographic examination, was markedly devitalized, if not actually aseptically necrotic. The wires caused the patient no pain and were not removed until two years after operation. They were found to be quite firmly in position and were removed by applying a reverse chuck and drilling them out. All wires were bright; the threads were sharp and showed no corrosion.

The last roentgenograms were taken on December 11, 1939, two years and seven months after operation (Fig. 6, C). There were some areas of absorption and compression of the weight-bearing cortex of the femoral head. Union at the site of fracture, however, was solid. Almost three years after operation, range of motion is 80 per cent. normal. There is no pain in the hip, and strength and stability are excellent. The ultimate fate of this hip joint, because of the aseptic necrosis, is at least uncertain, but anatomical and functional restoration of this old ununited fracture has been satisfactory.

Since the time of this first operation, six additional patients have been similarly operated upon. Anatomical restoration, union, and function have been obtained in five of the six cases. (See Table I and Figures 7, 8, 9, and 10.) The real end results can be determined only after the passage of many more years.

The one failure in the series which we are reporting resulted from the fact that one wire was inserted too far and penetrated the acetabulum. This was not known until roentgenograms were taken on the day following. It was necessary to reopen the incision and to withdraw the wire. This second operation was followed by infection, which resulted in osteomyelitis of the neck of the femur and non-union. Lateral and anteroposterior roentgenograms are now taken in the operating room before closing the incision. The position of the wires may be changed if the previous measurements from anatomical landmarks and the roentgenograms are found to be inaccurate.

#### DISCUSSION

Although it is possible to obtain improvement by many different operative procedures used in the treatment of ununited fractures of the neck of the femur, the ideal end result should approximate as nearly as possible a normal anatomical and functional restoration. Open reduction of the fracture with the insertion of tibial autogenous bone grafts to promote osteogenesis and union is the procedure which offers the best opportunity for obtaining this result. Objections to this procedure have included the fact that postoperative care requires long immobilization in a plaster cast with further atrophy of disuse and is frequently followed by arthritic changes and permanent lameness in the knee or ankle. Substitution of internal fixation for the plaster cast would appear to be a distinct step forward. It has been found possible, by using this procedure,

TABLE I

## CASES OF NON-UNION OF INTRACAPSULAR FRACTURE OF NECK OF FEMUR TREATED BY OPEN REDUCTION, INSERTION OF TIBIAL BONE GRAFT, AND THREADED-WIRE FIXATION

Case	Sex	Age (Years)	Previous Treatment	Duration of Non-Union	Date of Operation	Type of Operation	Roentgenographic Appearance of Femoral Head	Patient up in Wheelchair †	Patient Walking with Crutches †	Days in Hospital †	Weight-Bearing Permitted	Result
1. H. (Fig. 6)	Female	57	Whitman cast for 10 weeks	18 months	May 5, 1937	2 bone grafts 5 threaded wires No cast	Aseptically necrotic	7th post-operative day	20th post-operative day	33	After 4 months	Ossous union; excellent function; no pain, limp, or stiffness.
2. A. Mc. (Fig. 7)	Female	62	Whitman cast for 10 weeks	6 months	Oct. 27, 1937	2 bone grafts 4 threaded wires No cast	Viable	11th post-operative day	14th post-operative day	18	After 5 months	Ossous union, excellent function; normal motion; no limp or pain.
3. H. V. (Fig. 8)	Male	50	Cast for 4 months and 16 days	4 months and 20 days	May 27, 1938	2 bone grafts 3 threaded wires Cast for transportation home*	Viable (exceedingly atrophic)	7th post-operative day	12th post-operative day	16	After 5 months	Ossous union; limited motion; knee painful from earlier immobilization
4. H. H.	Male	45	Skeletal traction for 22 weeks	26 months	Dec. 2, 1938	1 bone graft 3 threaded wires No cast	Viable					Infection and sequestration of femoral head
5. H. A. (Fig. 9)	Female	53	Traction in Thomas splint for 9 weeks	11 months	Jan. 26, 1939	2 bone grafts 3 threaded wires No cast	Viable (poor)	12th post-operative day	14th post-operative day	20	After 10 months	Excellent, ossous union, painless motion and function
6. H. G.	Female	65	Traction in Thomas splint	5 months	May 15, 1939	1 bone graft 4 threaded wires No cast	Viable	About the 30th post-operative day	After 32 days	28	After 6 months	Painless motion; good strength, but roentgenographically union not yet solid.
7. H. C. (Fig. 10)	Female	16	Rest in bed with sandbags	6 weeks (unduced)	Aug. 21, 1939	2 bone grafts 4 threaded wires No cast	Viable	13th post-operative day	16th post-operative day	30	Beginning at 5 months	Ossous union, but not yet solid; good strength and motion.

\* Because this patient had to return to his home, which was 250 miles from Chicago, a short hip spica cast was applied.

† Excluding Case 4, patient H. H., whose progress was complicated by postoperative osteomyelitis, the following are averages for the six patients whose convalescence was uneventful:

Days in hospital.	.....	24
Postoperative days up in wheelchair	.....	13
Postoperative days walking with crutches	.....	18



FIG. 11

Photograph of specimens consisting of the proximal ends of the femora of a patient, aged fifty-four years, a laborer, who had been bedridden for several months prior to death from a pelvic neoplasm. The necks of the femora were fractured by direct pressure from the tensile-strength-testing machine. They were subsequently repinned in accurate position,—one with three Steinmann pins and the other with a Smith-Petersen nail. The breakdown force after pinning was again estimated. For the Smith-Petersen nail it was found to be 582 pounds; for the three Steinmann pins, 152 pounds. However, the distraction force, or that force required to pull the head of the femur off the pins or nail, was less than 100 pounds.

to shorten the total period of hospitalization to an average of twenty-four days.

Those who have observed the use of this method of treatment have been favorably impressed. Phemister<sup>14</sup>, in a paper read at the annual meeting of the American Academy of Orthopaedic Surgeons in Memphis, Tennessee, on January 19, 1939, stated: "One of the most successful procedures that has been employed in our Clinic is that used especially by Dr. Compere. It consists in open reduction of the fracture, curettage and apposition of fragments, insertion of one or two tibial bone pegs, and further fixation by the insertion of three threaded wires placed at slightly different angles, but directed as obliquely upward as possible in order to relieve the neck of shearing force."

Patients who are not markedly senile and feeble have been ambulatory with crutches within from two to three weeks after open reduction and internal fixation. Threaded wires are preferred to the Smith-Petersen nail for internal fixation, because they are less likely to sever blood vessels of the neck of the femur, including the nutrient artery. Nevertheless, King<sup>11</sup> has described the successful combination of the Smith-Petersen nail and bone grafts in the treatment of non-union of the neck of the femur. Although the number of threads on the wires which we use are 56 to the inch, holding power has been found to be surprisingly great. It has been tested effectively both from the standpoint of breakdown force required to bend the wires and to displace the

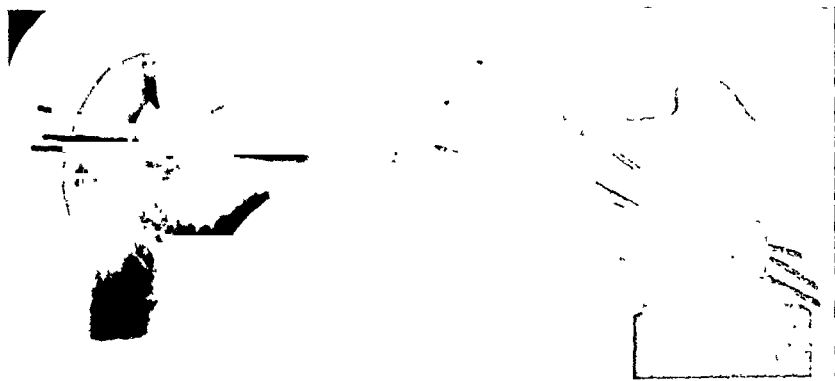


FIG. 10

Roentgenogram of two fractured femoral heads. These hips were obtained at necropsy from a female, aged 69 years, who had been bedridden for six months. The breakdown of force required after pinning with the three threaded wires was 480 pounds for the right hip and 510 pounds for the left hip. The distraction force required to separate the fragments after pinning was approximately three times as great as that needed where non-threaded material, such as the Smith-Petersen nail or Steinmann pins, was used. Details of these experiments will be found in a paper to be published in the near future.

head so pinned and the force necessary for pulling the wires out. An average pressure force of 543 pounds was necessary to displace the femoral heads of twelve hips obtained at necropsy, and fractured and immediately immobilized in reduced position with three threaded wires (Figs. 11 and 12).

Tibial bone grafts are favored more than the chip grafts suggested by Dickson <sup>7</sup>, because they supplement the immobilization and consist of more normal bone than that adjacent to the fracture.

Whether or not the femoral heads of hips subjected to this treatment of open reduction and internal fixation will be sufficiently revascularized to permit normal function for an indefinite period of time can be determined only after years of observation. The disturbed circulation resulting from the fracture may result in early senile changes in the hip joint, even though the head of the femur is viable and union of the fracture is obtained.

From the standpoint of our present knowledge of the physiology of the bones and joints, as well as from our observation of the cases which have been treated during the past three years, the method which is here presented (which does not produce stiffness either of the hip joint or of other joints of this extremity from long reimmobilization and at the same time does maintain accurate fixation of the fracture and adds the factor of autogenous bone grafts to aid in obtaining osteosynthesis) should help to reduce the incidence of poor end results in the treatment of this most difficult of all fractures.

When the procedure described is successful, the end result approximates both normal anatomical restoration and normal function. It should be urged, however, that these patients be forbidden to bear weight

within a period of less than five months after open reduction, regardless of how solid the union appears to be from roentgenographic observation or clinical examinations.

If weight-bearing is begun before sufficient time has elapsed to permit revascularization and revitalization of the head of the femur, necrosis and collapse of the cortex of the head may be anticipated. Early mobility, however, with both active and passive exercises for the entire extremity, should be encouraged. This muscular exercise helps to maintain the circulation of blood in the limb and to improve the tissue turgor or tone throughout the body, as well as to promote normal motion and physiology of the joints of the extremity. If the roentgenogram reveals aseptic necrosis of the head of the femur at the time of operation or subsequent to it, mobility and exercises should be instituted as described, but weight-bearing on the fractured hip should be delayed for at least one year or until there is roentgenographic evidence of replacement or revascularization of the femoral head.

#### ADVANTAGES OF THE AMBULATORY TREATMENT OF UNUNITED FRACTURES OF THE NECK OF THE FEMUR FOLLOWING OPEN REDUCTION, INSERTION OF TIBIAL BONE GRAFT, AND THREADED-WIRE FIXATION

1. An approximate anatomical relationship between the head, the neck, and the shaft of the femur is restored.
2. The period of hospitalization is greatly reduced (average, twenty-four days).
3. Recumbency in bed is shortened to from one to two weeks.
4. Unrestricted motion of knee, hip, and ankle is permitted and encouraged within one week after operation.
5. The patient is permitted to walk with crutches within an average of eighteen days after operation.
6. The small threaded pins do not endanger the surviving branches of the nutrient arteries of the femoral neck or head, nor do they obstruct attempts at revascularization.
7. Early mobility helps to maintain the circulation of blood and lymph in the injured limb and good tone or turgor throughout the body, as well as joint motion.
8. When union occurs, function is not complicated by such factors as painful knees or limitation of motion in knee and hip, which so commonly result from reimmobilization in plaster casts.
9. Atrophy of disuse of bones and muscles is markedly less than where casts or protracted periods of rest in bed are a part of the treatment.

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# A COMMON ANATOMICAL VARIATION IN THE SACRO-ILIAC REGION

BY MILDRED TROTTER, PH.D., ST. LOUIS, MISSOURI

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Clinical interest in the sacro-iliac region may justify a report on a frequently found variation in that region, despite the fact that neither its cause nor its effect is fully understood. This variation, an accessory articulation, may be present singly, doubly, unilaterally, or bilaterally. It is an articulation between the ilium and the sacrum.

The articular facets occur: on the sacrum, in the region of the lateral sacral crest and on a level with the first or second posterior sacral foramen; and, on the ilium, on the medial surface of the posterior superior iliac spine and on the tuberosity which is the rough area above the auricular surface of the bone. (See Figures 1, 2, 3, 4, 5, and 6.)

The surface of the facets is mostly flat but may be concave or convex with the opposing facet conforming. The peripheral outline is generally irregular and ovoid, with the longest diameter in a longitudinal plane and the shortest in a transverse plane. The average lengths of these diameters are approximately ten millimeters and eight millimeters, respectively (Trotter, 1937).



FIG 1

Pelvic bones of negro male, aged forty-eight years, showing unilateral single accessory sacro-iliac facets.

A series of 958 skeletonized pelvises from the Washington University Anatomical Collection were examined for the presence of this variation.

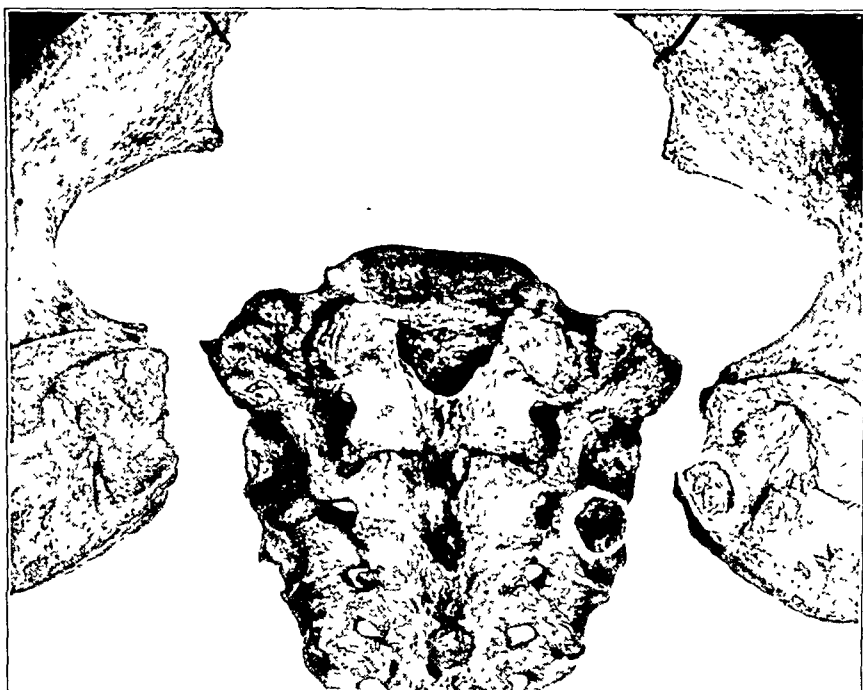


FIG. 2

Pelvic bones of white female, aged seventy-two years, showing unilateral accessory sacro-iliac facets.

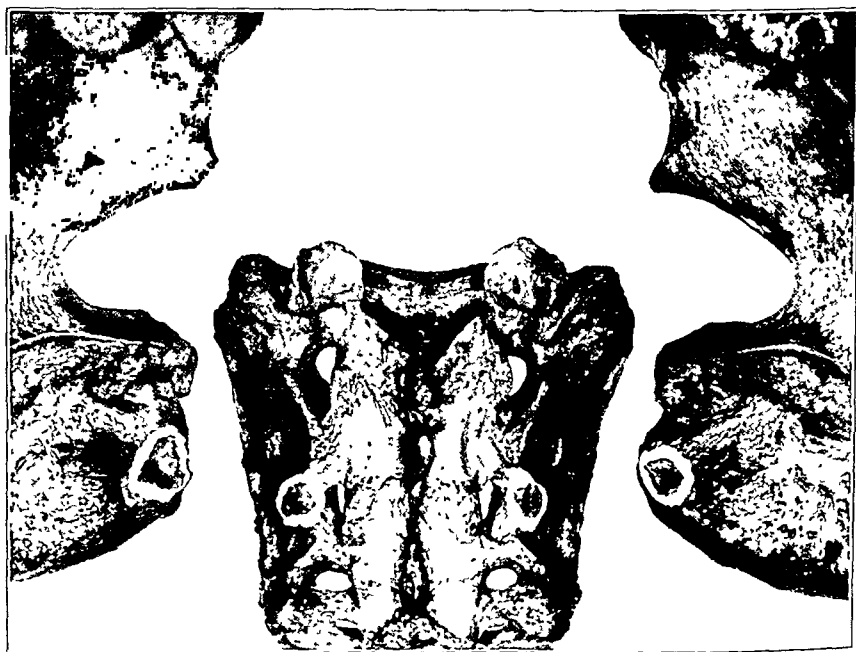


FIG. 3

Pelvic bones of negro male, aged twenty-seven years, showing bilateral accessory sacro-iliac facets.



The series included Whites and Negroes of both sexes, ranging in age from fifteen to eighty-eight years.



FIG. 4

Pelvic bones of negro female, aged thirty-five years, showing bilateral single accessory sacro-iliac facets



FIG. 5

Pelvic bones of white male, aged sixty-three years, showing single accessory sacro-iliac facets on one side and double accessory sacro-iliac facets on the other.

Facets for one or more articulations were found in 36 per cent. of the entire group examined. Approximately half of this number presented the variation bilaterally, and the location most often found with the bilateral distribution was at the level of the second posterior sacral foramen. In the unilateral cases these accessory facets were present slightly more often on the left side and at the level of the first posterior sacral foramen in the white group and on the right side at the level of the second posterior sacral foramen in the negro group. The differences were slight, however, and probably of no significance.

There was a marked racial difference in the incidence,—51 per cent. in the Whites and 21 per cent. in the Negroes. A sex difference also obtained: the variation was present in 52 per cent. of the white males and in only 39 per cent. of the white females; for the negro group, the percentage was 24 for the males and only 14 for the females. It should be noted that in both groups the males predominated: this was extreme among the Whites with 436 males and only forty-nine females; for the Negroes, 340 males and 133 females.

A study of the incidence from the standpoint of age disclosed that the number of accessory facets increased with increase in age. The average age of the white skeletons (fifty-nine years) was fifteen years more than that of the negro skeletons (forty-four years); the females of both groups were as old as the males. Thus, the sex differences in the two groups may not be attributed to a disparity in age. On the other hand, this may be a

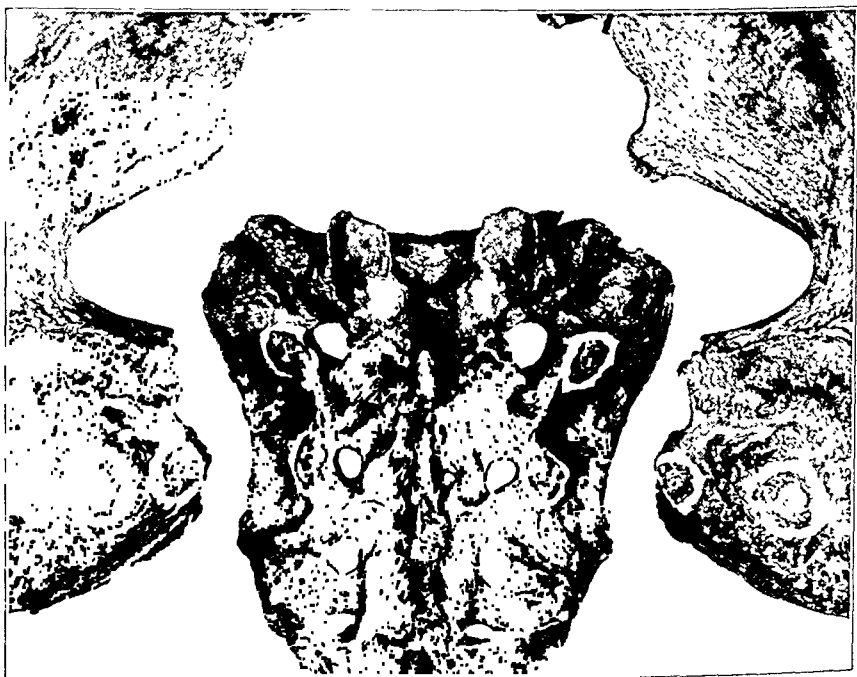


FIG. 6

Pelvic bones of white male, aged seventy years, showing bilateral double accessory sacro-iliac facets.

Seligmann explained the variation as a consequence of the upright posture of man, which has involved the sinking of the lower part of the spinal column into the pelvis—the pelvis sinks in a direction somewhat forward and downward—and there results a closer approximation of the posterior superior iliac spines to each other. Seligmann found this approximation to be more marked in the pelvis with accessory sacro-iliac joints than in those without such joints. In this connection, Stewart has made the suggestion that measurements on another series would be helpful, since Seligmann did not indicate the comparative widths of the sacra of the two groups.

Of the Washington University series, 593 pelvises, including those with and those without the variation, were measured for distance between the posterior superior iliac spines, for the least distance between the ischial tuberosities, and for the width of the sacrum. The pelvic bones were held together by strong rubber bands. No attempt was made to approximate the spread produced by intervening cartilage in the recent state at the sacro-iliac joints or at the symphysis. The distribution of material and the mean measurements with their probable errors for each group are summarized in Table II.

The sacra of the white group are wider than those of the negro group, but in both groups the sacra showing the variation are of the same width as those from which it is absent. It is, therefore, anticipated that both the distance between the ilia, posteriorly, at the level of the posterior superior iliac spines, and the least distance between the tuberosities, at whatever level it may be, will be greater in the white group than in the negro group. This relationship obtained, and, along with it, there was a definite tendency for the pelvises without the variation to have their ilia more widely separated posteriorly than did those pelvises with accessory

TABLE II

MEANS AND THEIR PROBABLE ERRORS OF MEASUREMENTS IN CENTIMETERS  
MADE ON ARTICULATED PELVES OF WHITE AND NEGRO MALES

	White Males		Negro Males	
	Accessory Sacro-Iliac Facets		Accessory Sacro-Iliac Facets	
	Present (222)*	Absent (189)*	Present (79)*	Absent (103)*
Distance between posterior superior iliac spines	7 52± 04	7 72± 04	6 83± 06	7 00± 06
Least distance between ischial tuberosities	6 18± 04	6 43± 04	5 52± 05	5 83± 05
Width of sacrum .	11 93± 13	11 88± 15	11 20± 05	11 08± 05

\* Number of pelvises measured.

sacro-iliac facets. In neither group and for neither measurement was this difference significant statistically. Of the four groups, the difference was three-tenths of a centimeter in one and less than three-tenths of a centimeter in three. The average widths of the sacra in the two races were approximately the same for the normal and the variable bones: eleven and nine-tenths centimeters for the Whites and eleven and one-tenth centimeters and eleven and two-tenths centimeters for the normal Negroes and the variable Negroes, respectively. The difference between the two groups of Negroes is much too small to be significant, but, nevertheless, it is in a direction which is not contributory to the differences in the distances between the ilia.

The difficulties of examining this region roentgenographically are many. A survey of the literature has not disclosed the record of accessory sacro-iliac joints in a roentgenogram. Dr. G. A. Seib of the Department of Anatomy took roentgenograms of a patient who complained of having had pain in the region of the distribution of the superficial peroneal nerve for several months; to relieve the pain partially, the thighs were slightly flexed. The roentgenographic view was postero-anterior. At the level of the second posterior sacral foramen on the right side, large accessory sacro-iliac facets were opposing one another on the sacrum and the ilium. The margins of the facets showed some arthritic deposit, which may have contributed to the differentiation of the facets from the surrounding bone.

#### SUMMARY

Accessory sacro-iliac articulations occur in man in varying percentages according to race, sex, and age.

The articular surfaces may be covered with either hyaline cartilage or fibrocartilage.

The posterior portions of the ilia are less widely separated in pelvises presenting the variation than in pelvises which are considered to be normal. However, these differences are not sufficient to be of statistical significance.

Roentgenographic examination of the pelvis in the living has shown accessory sacro-iliac facets in one case.

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## OSTEOCLASIS FOR SUPINATION DEFORMITIES IN CHILDREN \*

BY W. P. BLOUNT, M.D., MILWAUKEE, WISCONSIN

*From the Marquette Medical School and the Milwaukee Children's Hospital*

A careful search of the available literature reveals only the barest mention of supination deformity of the forearm resulting from flaccid paralysis. The clinical entity is entirely too frequent to be so ignored. In order to look well and to function reasonably well, the hand must be brought into a position of grasp, with the forearm in mid-position or in some degree of pronation. A potentially useful hand is of little practical value if it hangs dorsiflexed, with the palm up, at the end of a forearm which permits rotation of the palm in the direction of supination only by turning the elbow and by abducting the shoulder. If the shoulder is also weak, the difficulty becomes all the more acute.

In spite of the fact that osteoclasia is a simple and an effective method of correcting paralytic supination deformity, the author can find no mention of the use of this procedure in fourteen textbooks of orthopaedic surgery or in the periodical literature. Hoffa and Erlacher suggest osteoclasia for the correction of rachitic deformities of the forearm. Hoffa and many others have used this procedure in the realignment of malunited forearm fractures.

Steindler reports three spastic supination contractures out of thirty-four cases of pronation and supination deformity. In two cases relief was obtained by section of the supinator brevis and the biceps brachii. In the third case this procedure resulted in failure. No mention was made of osteotomy or of osteoclasia for the correction of either deformity. In a monograph on infantile paralysis, MacAusland does not discuss the occurrence of a supination contracture of the forearm. In available articles on congenital synostosis of the bones of the forearm with pronation deformity no mention is made of supination deformities from a similar cause. Hohmann mentions excessive angulation of the radius at the bicipital tubercle as a hindrance to rotation of the forearm. Tomesku discusses a similar phenomenon under the heading "Hypertrophy of the Radius."

In an excellent discussion of pronation and supination deformities, Destot includes even juvenile traumatic subluxation of the radial head, congenital deformity, and fractures, without mentioning paralysis as etiologically related to rotation deformities. His extensive investigation of fractures of both forearm bones has led him to believe that synostosis is a much less frequent cause of obstructed rotation than angulation.

\* Read in abstract at the Annual Meeting of the American Academy of Orthopaedic Surgeons, Memphis, Tennessee, January 17, 1939.

He even classifies the types of angulation with reference to the degree of restriction of motion. Angulation of both bones with the apices toward the interosseous space limits motion, irrespective of callus. With angulation of the bone away from the space, motion often persists in spite of apparent deformity. Destot emphasizes the disabling effect of rotation of the radius at the site of fracture and uses the term "*décalage*" to describe this deformity. In correcting it, he prefers osteoclasis to open osteotomy. He points out that movement of the humerus is complementary to that of the forearm in pronation and in supination.

Studies in rotation deformities of the forearm have been made largely in connection with forearm fractures. There has long been a debate over the optimum position of retention. Many of the early writers, such as Lonsdale, Malgaigne, Volkmann, Destot, Helferich, Ashhurst and John, and Bosquette, advocated a position of supination. Their choice was in part influenced by the exigencies of the treatment, which was usually by wooden splints. Even earlier, however, Hippocrates warned against supination and advocated mid-position or slight pronation, while Paré was definite in his recommendation of the mid-position. Recently, and especially since the advent of the roentgen ray and plaster-of-Paris dressings, the mid-position has been used for fractures of both bones below the insertion of the pronator teres. Some men, including Levinthal, advocate complete pronation for fractures near the lower end of the forearm.

Bagley, Cole and Evans, and others have emphasized the desirability of closed rather than open reduction in forearm fractures in children.

In 1933 a review of the end results in 195 cases of forearm fractures at the Milwaukee Children's Hospital forced the author to realize a number of insufficiently appreciated facts with regard to these fractures:

1. Non-union or malunion is almost unheard of when the *alignment* is maintained in the closed reduction of a forearm fracture in a child.

2. The degree of pronation and of supination during fixation of fractures of the middle and lower thirds of the forearm makes very little difference in the ultimate range of motion.

3. Even slight bowing in fractures of the middle third is frequently followed by prolonged or permanent limitation of pronation or of supination.

4. The incidence of deformity following open reduction in forearm fractures in children is greater than that following closed reduction, even when allowance is made for the fact that open reduction is done in the more difficult cases.

Realization of the truth of these statements paved the way for the deliberate fracture and displacement of the forearm bones of a child in the correction of deformity. In 1933, K. K. (Case 1), who had been under observation since 1922 because of an extensive paralysis of the left arm, was examined with regard to the correction of a fixed supination deformity which permitted pronation only to minus 70 degrees. There was marked atrophy below the elbow. The hand hung with the palm up, so that it

TABLE I  
RÉSUMÉ OF NINE CASES OF SUPINATION DEFORMITY TREATED BY OSTEOCLASIS

Case	Sex	Age at Operation (Years)	Arm	Diagnosis	Measurements		Date of Operation	Position	Cast Removed	Remarks
					Preoperative (Degrees)	Postoperative (Degrees)				
1. K. K.	Female	13	Left	Residual paralysis (post-polio-myelitic)	Apr. 28, 1932 Pronation: -70 Supination: 110	Feb. 8, 1934 Pronation: 10 Supination: 90	June 29, 1933	Slight pronation Pronation: 30 degrees	July 27, 1933 July 21, 1936	Osteoclasis performed twice Arthrod-esis of the thumb, June 24, 1936
		16				Apr. 6, 1936 Pronation: -30 Supination: 90 Nov. 18, 1938 Pronation: 10 Supination: 80	June 24, 1936			
2. B. S.	Female	10	Right	Brachial paralysis at birth (whole-arm type)	Mar. 7, 1932 Pronation: -20 Supination: 90	June 14, 1934 Pronation: 70 Supination: 30 Aug. 3, 1936 Pronation: 60 Supination: 70	July 27, 1933	Pronation: 90 degrees	Aug. 21, 1933 (changed) Sept. 7, 1933 (removed)	Arthrod-esis of right wrist, Mar. 11, 1934
3. G. M.	Male	8	Right	Residual paralysis (post-polio-myelitic)	Mar. 23, 1933 Unsignificantly	Oct. 18, 1937 Pronation: trace Supination: 120 Jan. 4, 1939 Pronation: 70 Supination: 65	Aug. 17, 1933	Neutral Pronation: 90 degrees	Sept. 21, 1933 May 6, 1938	Osteoclasis performed twice
		13					Mar. 30, 1938			
4. V. J.	Female	8	Left	Residual paralysis (post-polio-myelitic)	Mar. 13, 1934 Pronation: -30 Supination: 100	Mar. 12, 1934 Pronation: 35 Supination: 40 Oct. 22, 1938 Pronation: 0 Supination: 90	Aug. 17, 1933	Neutral	Sept. 14, 1933	Postoperative pronation only to neutral position

5. J. J.	Male	4	Right	Brachial paraly- sis at birth (whole- arm type)	Apr. 16, 1934 Pronation: 30 Supination: 100	June 4, 1934 Pronation: 90 Supination: 20 Nov. 22, 1937 Pronation: 40 Supination: 45	Apr. 19, 1934	Pronation: 90 degrees	May 14, 1934	Marked paraly- sis of hand
6. R. S.	Male	4	Right	Brachial paraly- sis at birth (upper- arm type)	July 23, 1934 Pronation: 10 Supination: 110	Jan. 7, 1939 Pronation: 70 Supination: 80	Apr. 4, 1935	Pronation: 90 degrees	May 6, 1935	Osteot- omy of right humer- us, May 29, 1936
7. J. M.	Male	15	Left	Chondro- dyspla- sia	Apr. 27, 1936 Pronation: 15 Supination: 90 Apr. 12, 1937 Pronation: 0 Supination: 90	Nov. 22, 1937 Pronation: 45 Supination: 0 Dec. 6, 1937 Pronation: 45 Supination: 30	Oct. 22, 1937	Pronation: 45 degrees	Nov. 22, 1937	Arrest of growth of low- er ra- dial ep- iphysis, Aug. 10, 1933
8. D. R.	Female	15	Left	Residual paraly- sis (post- polio- myelitic)	Feb. 2, 1938 Pronation: 0 Supination: 120	Apr. 28, 1938 Pronation: 20 Supination: 50 Jan. 7, 1939 Pronation: 10 Supination: 80	Feb. 3, 1938	Pronation: 90 degrees	Mar. 17, 1938	Arthrod- esis of thumb, Feb. 3, 1938
9. P. G.	Female	12	Left	Brachial paraly- sis at birth (whole- arm type)	June 21, 1938 Pronation: -45 Supination: 100	Aug. 18, 1938 Pronation: 80 Supination: 0 Nov. 4, 1938 Pronation: 50 Supination: 10	June 22, 1938	Pronation: 70 degrees	Aug. 3, 1938 (changed) Sept. 9, 1938 (removed)	Marked ulnar adduc- tion of hand



was practically useless. Manual stretching had proved futile. A tendon transplantation would have been of no avail. Roentgenograms showed bowing of the bones and a degree of osteoporosis usually obtained after prolonged fixation in plaster-of-Paris. This rarefaction suggested to the writer the possible value of osteoclasis in correcting the deformity. The immediate success led to the use of the same method in eight similar cases,—a total of eleven osteoclases. In all but one case complete fracture of both bones in the middle third was easily accomplished over a padded wedge. The procedure is simple.

#### TECHNIQUE OF OSTEOCLASIS

With the patient anaesthetized, the affected arm is placed in abduction and external rotation, so that the wrist is near the shoulder. The forearm is as near mid-pronation as obtainable, with the dorsum toward the table. In this position, no important soft structures lie between the bones and a padded sharp wedge. The surgeon should stand on a bench with his hands grasping the forearm on either side of the wedge. With a quick straight-arm thrust, the bones are fractured, usually incompletely. It is then necessary to reverse the force, manually breaking the bones entirely through. It is advisable to bend them back and forth several times to ensure complete fracture. In Case 7, the Thomas wrench was used in addition, because the size of the bones made manual osteoclasis difficult.

The forearm can then be pronated between 45 and 90 degrees and is

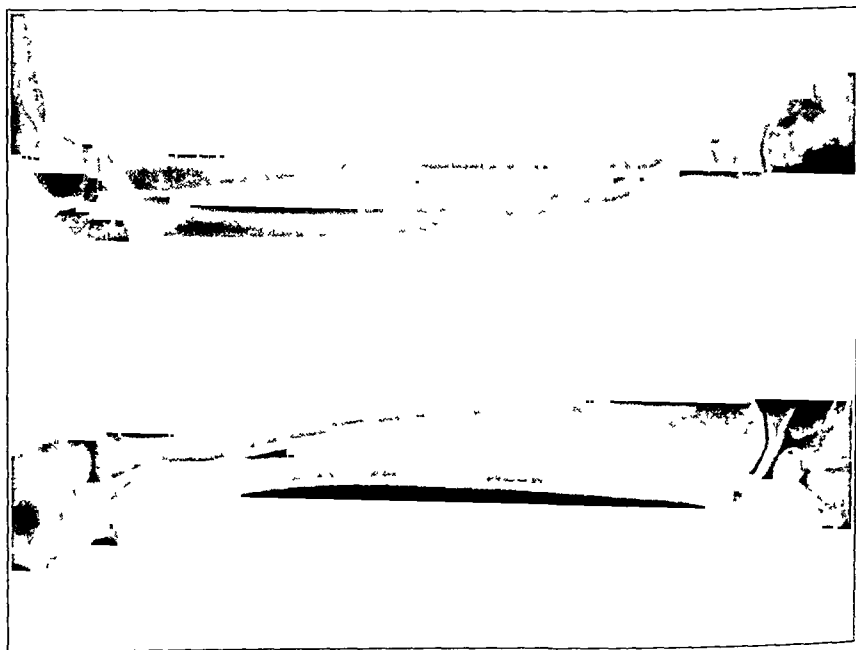


FIG. 1

Case 1. Anteroposterior and lateral views of the left forearm, taken on January 12, 1933, showing the delicate bones, thin cortices, and bowing of the radius laterally and of the ulna dorsally.

fixed in this position by a plaster cast, which extends from the axilla to the knuckles with the elbow in flexion. If correction is incomplete, it may be advisable to obtain further pronation under anaesthesia from two to three weeks later.

It is sometimes necessary to apply a second cast. In Case 8, longer fixation would probably have given a good instead of a fair result. Six to eight weeks of fixation instead of four are probably desirable in older children.

Table I summarizes the nine cases: four of these were the result of residual poliomyelitis; four, of brachial palsy at birth; and one, of chondrodysplasia. Five of the patients were females and four were males. The left arm was involved in five cases and the right in four.

#### ILLUSTRATIVE CASE REPORTS

**CASE 1:** K. K., female, with residual poliomyelitis, was first seen at the Milwaukee Children's Hospital on November 27, 1922, at the age of two years. There was marked wasting of the left upper extremity with relaxation of the capsule of the shoulder joint. The deltoid, the triceps brachii, and the biceps brachii had fair power. There was ulnar deviation of the hand. The thumb was almost completely paralyzed. There was a flexion contracture of the left elbow of 20 degrees. Pronation exercises and stretching of a supination contracture were begun, and physiotherapy under careful observation was continued for several years.

On December 10, 1931, a Steindler transplantation of half of the flexor pollicis longus was performed. The patient recovered normally. On April 28, 1932, pronation was minus 70 degrees, and supination was 110 degrees. Anteroposterior and lateral roentgenograms of the left forearm were taken on January 12, 1933 (Fig. 1). The radius was considerably longer than the ulna and was bowed laterally in the anteroposterior view. Both bones were delicate, with thin cortices. The epiphyseal lines were normally open. In the lateral view it is seen that the ulna was bowed at the distal end with the convexity dorsally.

On June 29, 1933, a manual osteoclasia over a wedge was performed, and a cast was applied with the forearm in slight pronation. Support was removed, and physiotherapy was resumed on July 27, 1933. A roentgenogram taken on this date showed adequate callus to maintain the new position. There was a transverse fracture of both bones in the middle third with considerable rotation of both fragments. The lateral bowing of the radius was obliterated. The dorsal bowing of the ulna was much less evident.

On February 8, 1934,



FIG. 2-A

FIG. 2-B

FIG. 2-A: Case 1. Characteristic position of the left hand on April 6, 1936, previous to the second osteoclasia.

FIG. 2-B: Case 1. Maximum active pronation of minus 30 degrees previous to the second osteoclasia.

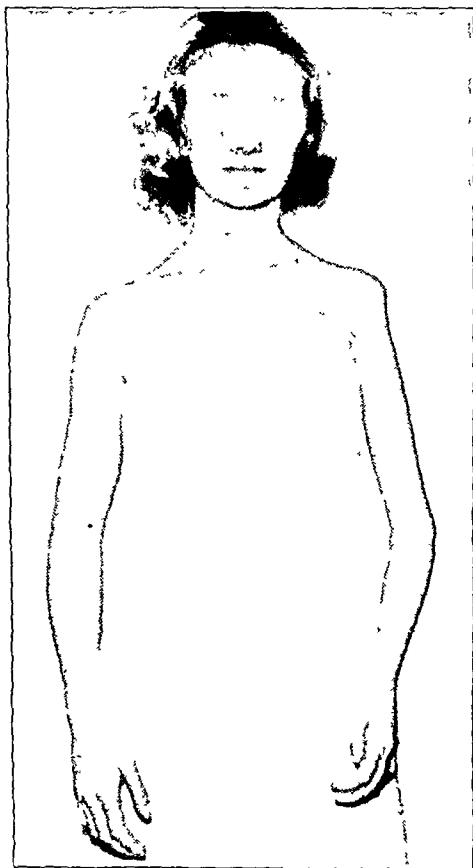


FIG. 3-A

CASE 1. Characteristic position of the hand on November 18, 1938, following the second osteoclasis.

shape of the bones very closely simulated that of the normal right side. On the left, there was a tunnel through the shaft of the first metacarpal at the junction of the middle and distal thirds, at the site of the attachment of the transplanted tendon. The length of the right radius was twenty-one and five-tenths centimeters; that of the left, twenty and three-tenths centimeters. The bones on the left were more delicate than on the right, but there was not the discrepancy that previously existed. In both forearms the radii were straight. The ulna on the left was straight, while that on the normal right was slightly bowed with the convexity dorsally.

While there had been considerable recurrence of the supination deformity, the range of active motion from a position of supination of 80 degrees to a neutral position was sufficient to give the graceful appearance of the hand noted in Figure 3-A.

CASE 3. G. M., male, five years of age, was admitted to the Milwaukee Children's Hospital on September 16, 1930, because of marked weakness of the right arm, which had been present since an attack of poliomyelitis in 1928. Power in abduction of the right shoulder was poor; other motions were fair or better. There was only a trace of power at the right elbow. Extension of the right wrist was fair; flexion was poor. There was good power in flexion of the right middle finger; other finger flexors were deficient. Extension of the fingers at the metacarpophalangeal joints was good. Distal to this, power was poor. There was a supination deformity of the right forearm with no other resistant contracture.

there was still power in opposition of the left thumb. Pronation was possible to 10 degrees and supination to 90 degrees.

Examination on April 6, 1936 (Figs. 2-A and 2-B) showed a loss in the range of motion of the left forearm as follows:

	<i>Right</i>	<i>Left</i>
Pronation . . . .	80 degrees	—30 degrees
Supination . . . .	90 degrees	90 degrees

On June 24, 1936, a second osteoclasis was done in conjunction with arthrodesis of the thumb at the metacarpocarpal joint. The osteoclasis was easy, but only 30 degrees of pronation could be obtained. With the forearm in this position, a cast was applied from the axilla to the base of the knuckles, including the thumb. On July 21, 1936, the cast was removed, and a short cast was applied to hold the thumb in position. This cast was replaced by a thumb splint on August 18, 1936.

Examination on November 18, 1938 (Figs. 3-A, 3-B, and 3-C), showed the following range of motion:

	<i>Right</i>	<i>Left</i>
Pronation . . . .	80 degrees	10 degrees
Supination . . . .	90 degrees	80 degrees

With some force, pronation was possible to 30 degrees.

Anteroposterior and lateral roentgenograms of both forearms on December 17, 1938 (Figs. 4-A and 4-B), still showed a disturbance of the internal architecture at the site of the two osteoclasses. The general



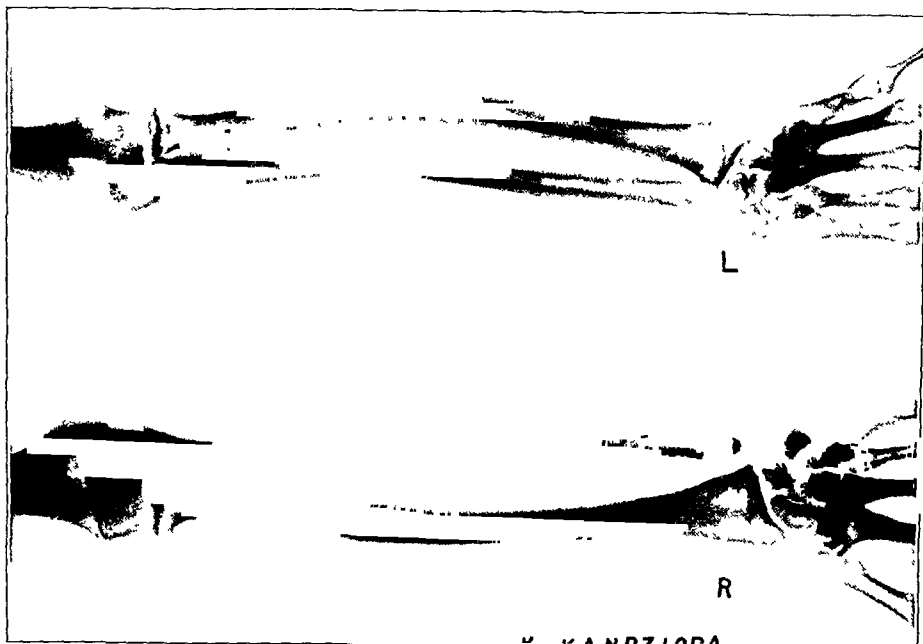


FIG. 4-A

Case 1. Anteroposterior view of both forearms after the second osteoclasis.

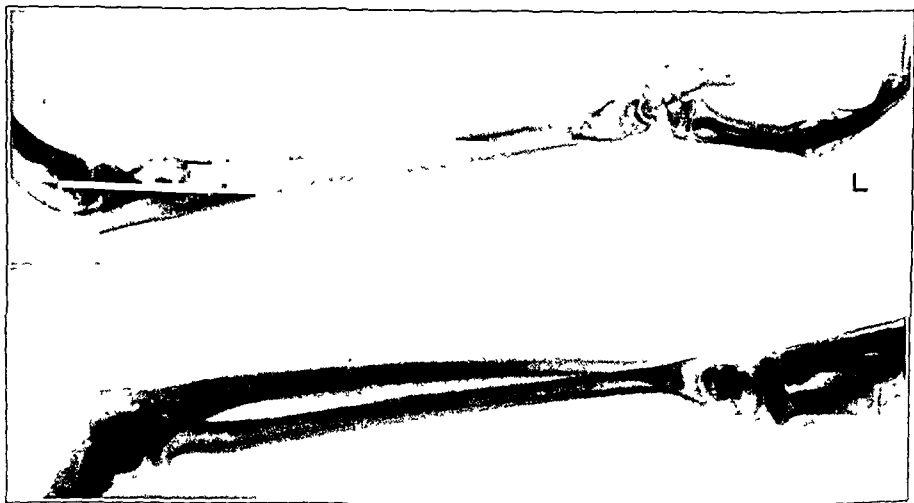


FIG. 4-B

Case 1. Lateral view of both forearms after the second osteoclasis.

also displacement of the distal ulnar fragment radially and volward. The cast was removed on May 6, 1938. Roentgenograms (Fig. 8) taken on May 23, 1938, showed firm union and good alignment of both bones. The irregularity was beginning to disappear.

On June 6, 1938, pronation was possible to 55 degrees and supination to 50 degrees. On January 4, 1939, the right arm hung gracefully at the side (Fig. 9-A). Pronation was 70 degrees and supination, 65 degrees (Figs. 9-B and 9-C).

Roentgenograms (Figs. 10-A and 10-B) showed curves which were nearly normal. They are offered, not as a proof of anything, but as interesting studies of the change in architecture of the bones. The test of improvement is entirely clinical.

## DISCUSSION

Marked limitation of pronation as the result of paralysis of the muscles of the arm and forearm seems to be dependent upon several factors. Vicious muscle pull and ligamentous contracture bring about and perpetuate bone deformity, often in spite of energetic conservative treatment. The roentgenograms usually show delicate bones of the forearm, bowing of the distal end of the radius with the convexity laterally, and bowing of

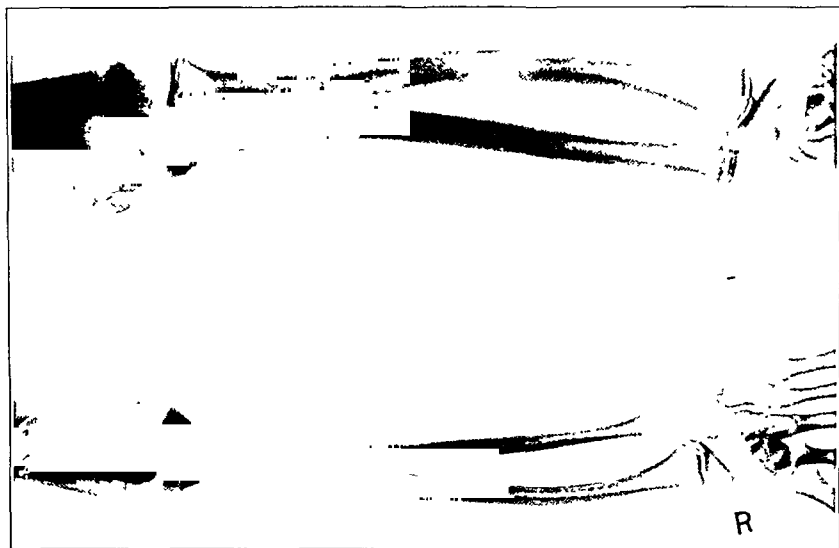


FIG. 5-A

Case 3. Anteroposterior views of both forearms before the second osteoclasis.

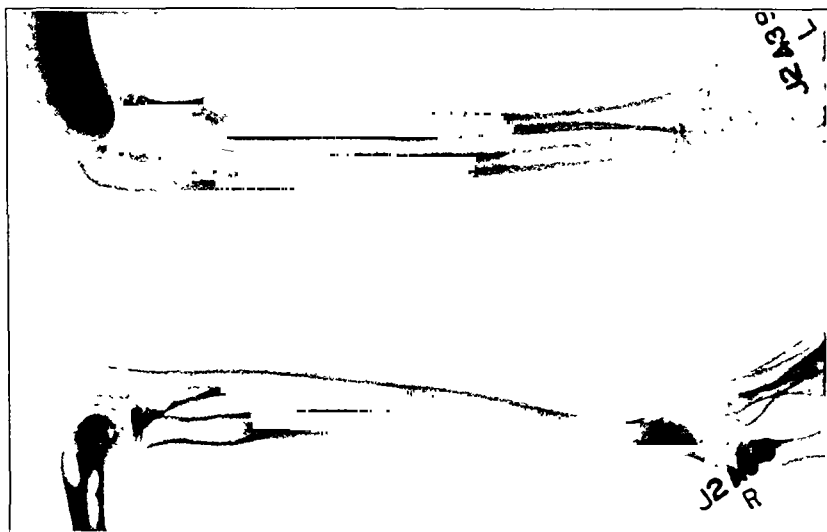


FIG. 5-B

Case 3. Lateral views of both forearms before the second osteoclasis.

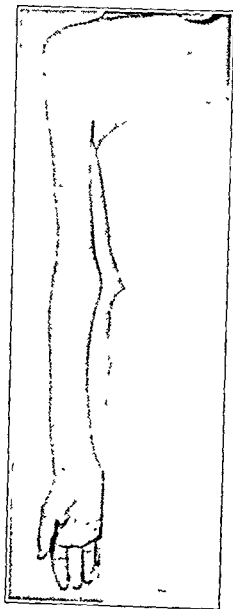


FIG. 6-A

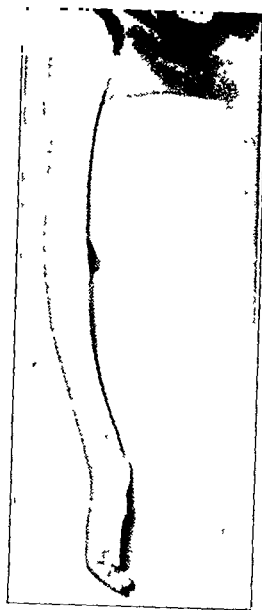


FIG. 6-B



FIG. 6-C

Case 3. Appearance of the right arm before the second osteoclasis. The position is particularly awkward with the elbow flexed.

a short ulna with the convexity dorsally. Ulnar adduction of the hand frequently accompanies these changes. Unless a profound effect can be exerted by the transplantation of muscles, a direct attack on the bones is suggested.

As exemplified in forearm fractures, the correction of the bone deformity in children is better accomplished by osteoclasis than by open osteotomy. It is a simpler procedure. The scar and the slight risk of infection are avoided. More important is the rapid and more normal bone healing without the disturbance of blood supply incident to open operation. It is necessary to overcorrect the deformity greatly, because of the rapid loss of part of the pronation and the tendency to gradual recurrence. The latter is due to persistence of the original deforming factors. It may be necessary to repeat the osteoclasis after a few years. Muscle transplantation, subsequent to the osteoclasis, may prevent recurrence in a few cases.



FIG. 7

Case 3. Position in plaster after the second osteoclasis.

In the nine cases in which osteoclases were performed, there were five good results and four fair or poor results

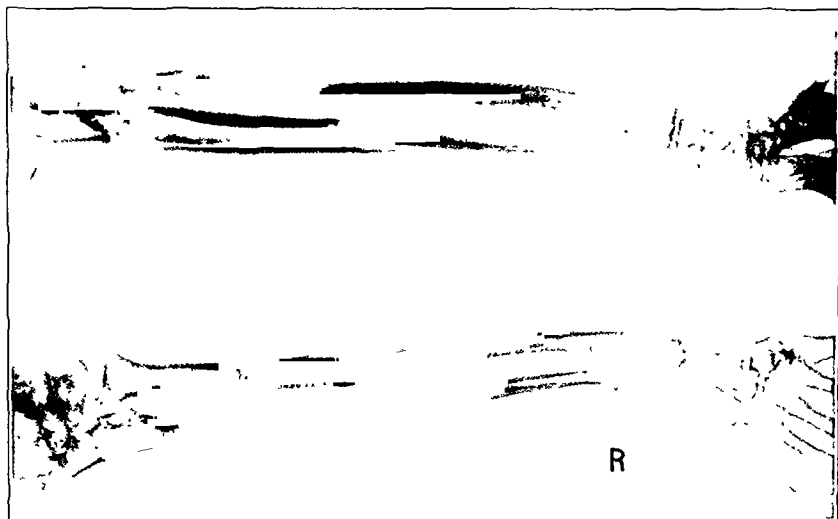


FIG. 8

Case 3. Two views of the right forearm after removal of the plaster.

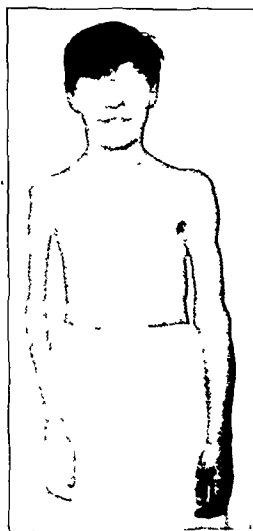


FIG. 9-A



FIG. 9-B

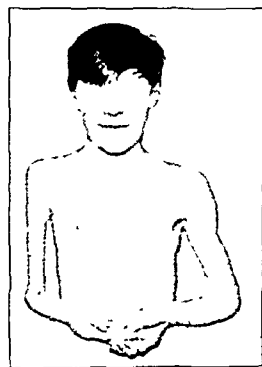


FIG. 9-C

Case 3. Appearance one year following the second osteoclasis.

(Table II). It is evident that the best and most permanent results have been obtained in cases in which the chief desideratum is improvement of the cosmetic result. In the first case the deformity was incompletely corrected at each operation. The second osteoclasis was performed before the importance of overcorrection was understood. A second manipulation under anaesthesia two weeks later might have given full overcorrection. The final range of motion was somewhat limited in this case, but the habitual position and function were improved, and the outcome was classed as fair.

In Case 3 the result was poor following the first operation, in which the forearm was left in mid-position. Following the second operation, in which there was adequate overcorrection, the position was good.



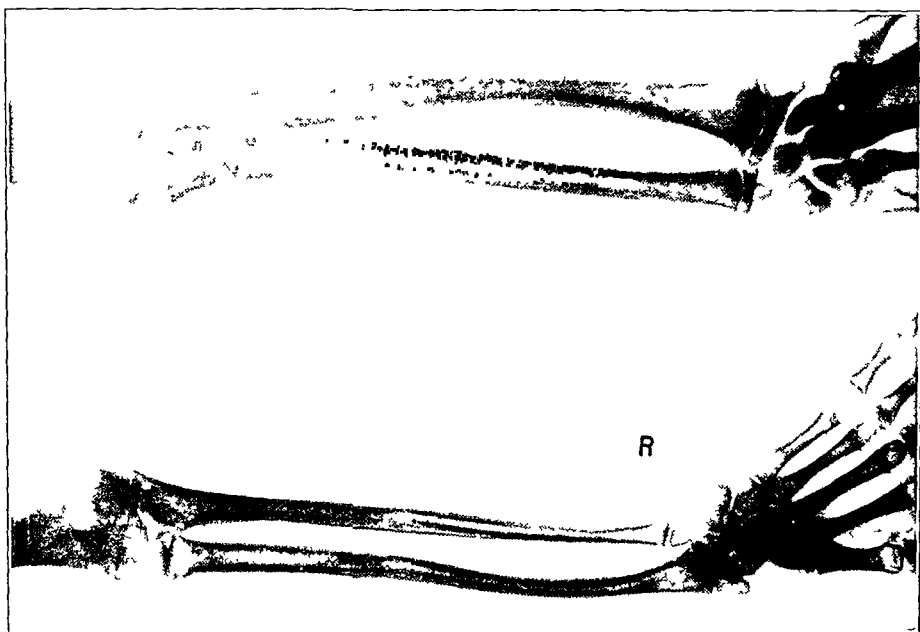


FIG. 10-A

Case 3. Anteroposterior views of both forearms, nine months after the second osteoclasis. The radial bowing on the right is diminished.

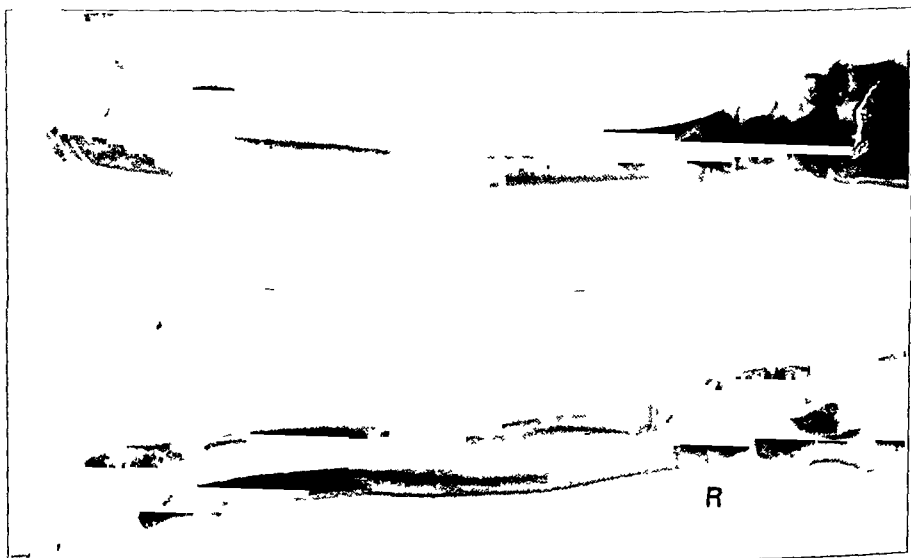


FIG. 10-B

Case 3. Lateral views of both forearms, nine months after the second osteoclasis. The ulnar bowing on the right is obliterated.

The fourth case was another of the early ones. At the follow-up examination reoperation was advised. When this has been carried out, the result should be good in this case also.

In Case 8 the result was good six weeks after removal of the cast. There appeared to be solid union. Subsequent examination nine months

TABLE II  
END RESULTS IN NINE CASES OF SUPINATION DEFORMITY  
TREATED BY OSTEOCLASIS

Case	Sex	Age at Operation (Years)	Cause of Deformity	Rotation Obtainable (Degrees)	End Result	Remarks
1. K. K.	Female	13 16	Poliomyelitis	Pronation: 10 Supination: 80	Poor Fair	Not over-corrected
2. B. S.	Female	10	Brachial paralysis at birth	Pronation: 60 Supination: 70	Good	
3. G. M.	Male	8 13	Poliomyelitis	Pronation: 70 Supination: 65	Poor Good	Not over-corrected
4. V. J.	Female	8	Poliomyelitis	Pronation: 0 Supination: 90	Poor	Secondary osteoclasis advised
5. J. J.	Male	4	Brachial paralysis at birth	Pronation: 40 Supination: 45	Good	
6. R. S.	Male	4	Brachial paralysis at birth	Pronation: 70 Supination: 80	Good	
7. J. M.	Male	15	Chondrodysplasia	Pronation: 45 Supination: 30	Good	
8. D. R.	Female	15	Poliomyelitis	Pronation: 10 Supination: 80	Fair	Partial recurrence
9. P. G.	Female	12	Brachial paralysis at birth	Pronation: 50 Supination: 10	Good	

later showed that angulation of the ulna had progressed, limiting pronation. The habitual position was more nearly neutral than it had been. The result was fair. The improvement was obtained at the sacrifice of motion, however. In Cases 2, 6, and 7 the range of motion was actually increased. In Case 9 it was the same as before the osteoclasis and will probably increase.

#### SUMMARY

1. Not infrequently supination deformities of the forearm follow the flaccid paralysis of the lower-arm type of brachial palsy at birth or poliomyelitis.

2. Very little has been written with regard to the significance and treatment of these deformities.

3. Persistent supination of the forearm renders ineffective an otherwise useful hand and is cosmetically objectionable.

4. Deformities of this type resist correction by plastic soft-tissue operations only.

5. In children simple osteoclasia of the middle third of the forearm safely corrects the deformity.

6. There is usually a rapid loss of part of the correction. All possible pronation up to 90 degrees should be maintained in plaster from four to six weeks.

7. Gradual partial recurrence of the deformity will take place.

8. Following osteoclasia an increase rather than a diminution of the range of motion is frequently obtained, and this motion is through a more useful arc.

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## MYOSITIS OSSIFICANS TRAUMATICA \*

BY AUGUSTUS THORNDIKE, JR., M.D., F.A.C.S., BOSTON, MASSACHUSETTS

*From the Department of Hygiene, Harvard University*

One hesitates to present a subject often considered to be controversial, but sane conclusions may be drawn only by thorough airing of controversial points. Although it is difficult to prove the presence of an actual myositis without microscopic examination of tissue, clinical signs do lead to definite pathological interpretations. Cobb has stated: "But why confine ourselves to the microscope? Certainly there are other ways of recording abnormality of the human organism besides visual observation of fixed and sectioned tissue." There is, however, microscopic proof of actual myositis, with its resultant necrosis and degeneration; Bowers and Geschickter and Maseritz have reported proved cases. Ten years ago, Eliason stated that he was using the term *ossifying hematoma* "advisedly", more properly to describe the pathology, and Watson-Jones and Roberts have inferred that the term *myositis ossificans* is incorrect. Yet the term is still used to describe a definite clinical entity. Painter and Sudeck have suggested that there is an individual variation in ossifying tendencies or "diatheses". These "diatheses" undoubtedly exist, but Eliason's statement that "the condition is not inflammatory in any respect" cannot generally be permitted to pass without challenge.

An analysis of a portion of the literature on this subject reveals that the pathological material removed and examined has been only from late or healed cases, when any active myositis would have completely disappeared. On the other hand, that myositis exists early, during the first two weeks after the injury, is most apparent clinically. The muscles involved in the contusion are swollen and extremely tender during this stage, and the loss of function is extraordinary. The classical signs of "tumor", "dolor", and "calor" are all present. The author believes that there are signs of muscle inflammation in the early stages of development of a true "myositis ossificans", and that, as ossification later takes place, the inflammation subsides and eventually disappears when the muscle function returns to normal. As late as five months after an injury, Bowers has found degenerated muscle fibers in a specimen removed at operation. Geschickter and Maseritz have stated: "Degeneration of muscles, hyperplasia of connective tissue, and organization of hemorrhage are the earliest histological manifestations." It is the author's conviction that the pathological picture in sequence is: (1) a severe deep-muscle contusion, accompanied by the tearing of muscle fibers and capillaries and the loosening of periosteal cells; (2) hemorrhage, with the accompanying inflammatory reaction that one would expect in hematoma formation; and

\* Read before the Boston Orthopaedic Club, December 14, 1938.



FIG. 1-A

Case 15. Femur, four weeks after injury.

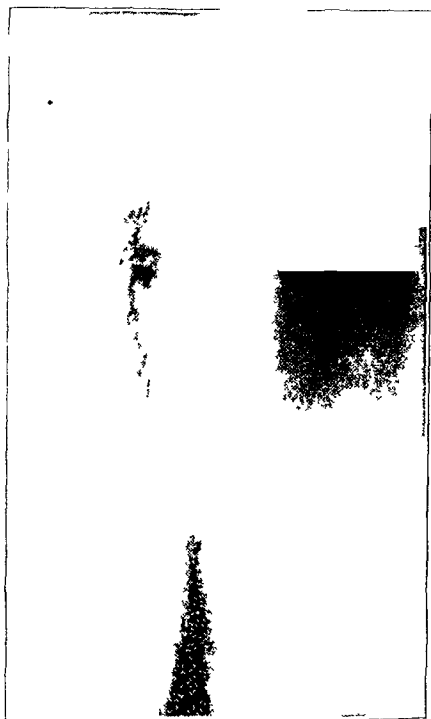


FIG. 1-B

Case 15. Femur, six weeks after injury.



FIG. 1-C

Case 15. Femur, twelve weeks after injury.

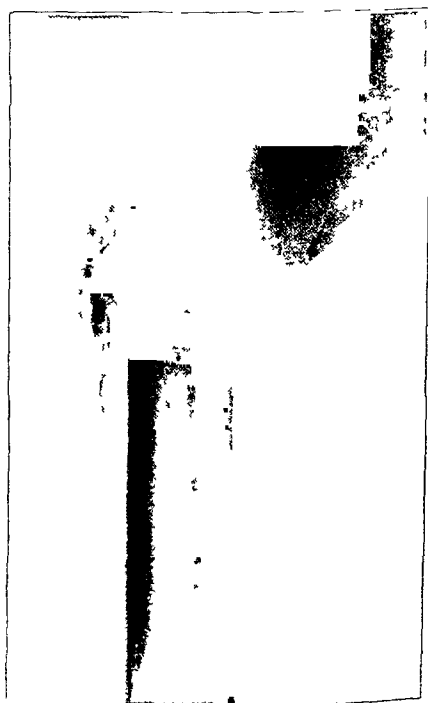


FIG. 1-D

Case 15. Femur, twenty-four weeks after injury.

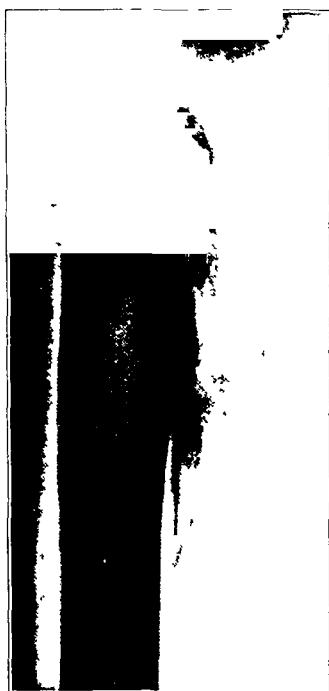


FIG. 2-A

Case 16. Femur, twelve weeks after injury.

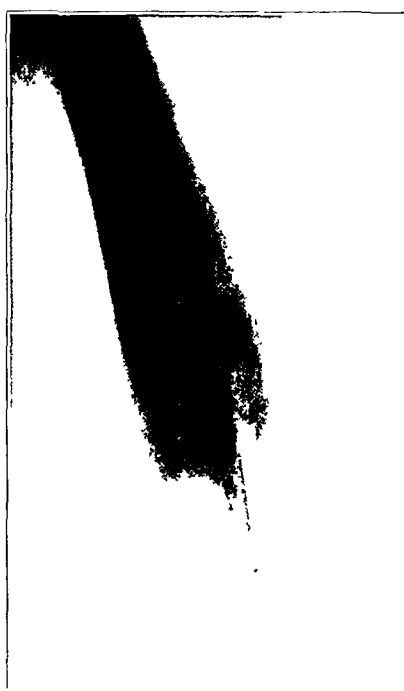


FIG. 2-B

Case 16. Femur, twenty-two weeks after injury.

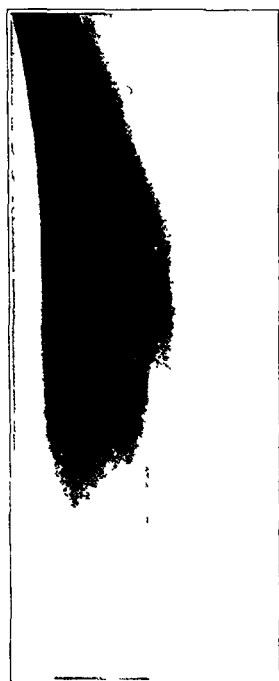


FIG. 2-C

Case 16. Femur, twenty-eight weeks after injury.



FIG. 2-D

Case 16. Femur, fifty-six weeks after injury.

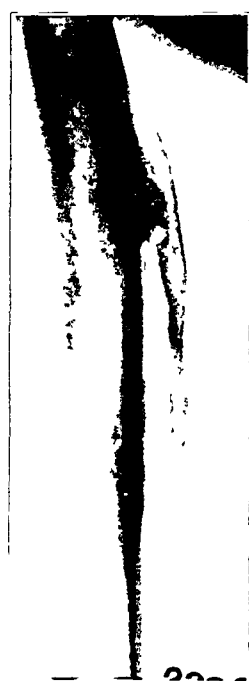


FIG. 2-E

Case 16. Femur, 112 weeks after injury.

TABLE I

DATA IN REGARD TO INVOLVEMENT AND ABSORPTION IN TWENTY-FIVE CASES OF  
MYOSITIS OSSIFICANS TRAUMATICA

Case No.	Patient	Bone and Muscle Involved	Time of Absorption	Absorption Complete
1	J. H. D.	Left femur, quadriceps femoris	14 months	Yes
2	D. B. C.	Left femur, quadriceps femoris	Has never been absorbed	No
3	P. J.	Left tibia and fibula, interosseous septum	Has never been absorbed	No
4	G. K. S.	Right femur, quadriceps femoris	Has never been absorbed	No
5	J. P. M.	Left femur, quadriceps femoris	Has never been absorbed	No
6	S. S. W.	Right humerus, brachialis	9 weeks	Yes
7	G. T. K.	Left humerus, deltoid	Was being absorbed in March 1937	No
8	W. W.	Right tibia, tibialis anterior	Has never been absorbed	No
9	C. R. A.	Left fibula, peronei Right femur, quadriceps femoris	Have never been absorbed	No
10	W. F. S.	Right femur, quadriceps femoris	Has never been absorbed	No
11	G. H. H.	Right femur, quadriceps femoris (vastus intermedius)	3 months	Yes
12	D. S. G.	Right humerus, brachialis	3 months	Yes
13	C. C. J.	Right radius, biceps brachii	Case not followed up	?
14	A. A. L.	Right humerus, brachialis	Case not followed up	?
15	N. C. U.	Left femur, quadriceps femoris	Still being absorbed	No
16	L. S.	Right femur, quadriceps femoris	After 5 years still being absorbed	No
17	E. E.	Left femur, quadriceps femoris	Still being absorbed	No
18	D. G. S.	Left humerus, triceps brachii	2 years	Yes
19	L. B. H.	Right humerus, deltoid	3 months	Yes
20	T. H. M.	Left tibia, tibialis posterior	Still being absorbed	No
21	W. G.	Left femur, quadriceps femoris	2 months	Yes
22	B. B.	Right femur, quadriceps femoris	2 months	Yes
23	C. P.	Right femur, quadriceps femoris	Still being absorbed	No
24	B. W.	Right femur, quadriceps femoris	2 months	Yes
25	F. M.	Left humerus, brachialis	Has never been absorbed	No

(3) hematoma absorption, in which stage the ossification takes place. The latter occurs during the healing stage, and not during the acute hemorrhagic and inflammatory stage. Furthermore, Kolodny has reported that an early case in the ossification stage was mistaken microscopically for osteogenic sarcoma, the cellular elements being so much more prolific than in the structure of normal bone callus seen in a fracture. In addition, Oliver, Eliason, and Bowers have all agreed that the late stages of ossification show definite normal "cancellous bone" microscopically.

What happens to the ossification eventually? Very few of us have had the opportunity of following such cases for a period of years. Several

of the cases listed in Table I have been followed for over a year, several for two years, and one for five years. Some of these ossifications completely disappear; some do not. In the author's series of twenty-five cases, nine, or 36 per cent., have been absorbed. In one very severe case the ossification has been only partially absorbed in five years. The criteria for absorption seem to be mainly size and location, as well as individual diathesis. The smaller ossifications are absorbed, and those on the upper extremity, except near the elbow joint, seem to have a greater ability to disappear completely. Those occurring in the belly of a muscle become dormant and painless, and clinically the muscle involved is restored to normal function, even in the most severe cases when regression is incomplete. The myositis heals, and normal muscle function ensues, although the ossification may not be entirely absorbed. An ossification which occurs at the origin or the insertion of a muscle near a joint, however, may regress and become dormant, but the muscle and joint function is never restored to normal. In the author's series of twenty-five cases—all in school or college athletes—the incidence as to location is most striking. The bone most frequently involved was the femur (Table II), and this was doubtless due to the type of game and the resulting exposure of that part to severe trauma. In all but four of these cases,



FIG. 3

Case 18. Humerus, nine weeks after injury.

TABLE II  
SITE OF INVOLVEMENT IN TWENTY-FIVE PATIENTS\*  
WITH MYOSITIS OSSIFICANS TRAUMATICA

Bone Involved	Cases	
	No.	Per Cent.
Femur . . . . .	14	51.9
Humerus . . . . .	7	25.9
Tibia . . . . .	3	11.1
Fibula . . . . .	2	7.4
Radius . . . . .	1	3.7
Total . . . . .	27	100.0

\* In one of these, the tibia and the fibula were involved; in another, the fibula and the femur were affected.



the injury was received while playing football; in the other four cases the trauma was sustained while playing lacrosse, hockey, or polo, or was the result of an automobile accident.

During the convalescent period, the diagnosis of a severe muscle contusion—the so-called “Charley-horse”—is made. This term has been



FIG. 4

Case 25. Elbow, fifty-two weeks after injury.

carried down by word of mouth from trainer to trainer for two generations. Perhaps it might be well to describe how it first came to be used. In about 1890, the Sioux City baseball team of the old Western Baseball League had an old broken-down white horse named “Charley”. The limp of this horse was quite typical, and often, when a player appeared with a similar limp, someone would say, “Here comes Charley.” From this expression the term “Charley-horse” was derived.<sup>6</sup>

The diagnosis of myositis ossificans is clear-cut and apparent. A muscle contusion, receiving the usual careful physiotherapy, in the course of four or five days does not seem to be responding properly to treatment. The muscle involved becomes more acutely tender, more firm, and hot, and loses function day by day. The striking feature is that the muscles involved in the contusion become more acutely sensitive to ordinary light massage. Of course, all such treatment should cease promptly. In fact,



FIG. 6

Case 3. Tibia and fibula, fifty weeks after injury.

Operative removal of the ossification is contra-indicated in any case in which it occurs in the belly of a muscle or on the shaft of a bone. Only in those cases in which it occurs at the origin or the insertion of a muscle or tendon, and where the adjacent joint function is markedly impaired, is operation indicated, and then only after the process has become entirely dormant, twelve to twenty-four months after the injury. It is a mistake to attempt to remove any ossification early when the cells appear microscopically similar to those of osteogenic sarcoma. Recurrence of the original myositis ossificans in even greater magnitude than that of the first instance will most certainly ensue, if early operative measures are instituted.

Evacuation of the hematoma in the early stages of its formation is contra-indicated. To accomplish this completely in deep-muscle contusions requires careful surgery, necessitating further trauma and hemorrhage in dissection and suture, and tissue repair later, before active motion and function of injured muscles can be started. The restoration of normal function, following surgical evacuation of a deep-muscle hemorrhage, is unduly prolonged. Since evacuation of a hematoma, other than a superficial one, by a needle puncture is incomplete, the hazards are too great. Furthermore, the danger of spreading wider the loosened periosteal cells by either surgical or needle-puncture evacuation is real. The

aim of treatment should be to control the hemorrhage early by the application of cold and a compression bandage, minimizing the size of the hematoma in so far as is possible by conservative measures only.

### CONCLUSIONS

1. Myositis ossificans traumatica is an inflammatory process of muscle in its early stages and before ossification is actually demonstrated by the roentgen ray. "Tumor", "dolor", and "calor" are all present at this stage.

2. This inflammatory process gradually subsides as ossification takes place.

3. The ossification is gradually absorbed in part and sometimes in full, depending upon its size and location. The muscle function returns to normal, except in those instances where the ossification occurs near a joint.

4. Treatment necessitates the immediate application of cold and a compression bandage to control hemorrhage, and later heat to aid in the absorption of the hematoma. Of great importance is the avoidance of massage on all severe and tender muscle contusions.

5. Operative removal of the ossification is indicated only in those cases in which it occurs near a joint in the origin or the insertion of a muscle, where joint function is permanently impaired, and then only from twelve to twenty-four months after the injury.

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# RELATION BETWEEN REDUCED ASCORBIC-ACID LEVELS OF THE BLOOD PLASMA AND RHEUMATOID ARTHRITIS

BY RICHARD H. JACQUES, M.D., COLUMBUS, OHIO

For the past several years the possibility of an etiological relation between the ascorbic-acid content of the blood plasma and rheumatoid arthritis has captured the interest of several investigators.

It has been demonstrated that body resistance is lowered in pre-scorbutic states.<sup>3</sup> It has also been demonstrated that the need for vitamin C is increased in any local or generalized infection.<sup>1</sup> Wolbach and Howe<sup>2</sup> revealed that the scorbutic state is due to the inability of cells of supporting tissue to produce intercellular substances and to maintain existing intercellular substances. It has been suggested that a diminished ascorbic-acid content of the blood plasma may aggravate the symptoms of arthritis by increasing the interstitial fluid, due to increased capillary permeability.<sup>6</sup> With prolonged vitamin-C deficiency there are degenerative changes in interstitial tissue with replacement held in abeyance or accomplished by imperfect collagen. Since the tensile strength of the finer vascular bed is largely due to its connective-tissue support, a loss of capillary tonus and increased capillary permeability would be a logical result. Rinehart<sup>4</sup> reported that a relatively early manifestation of vitamin-C deficiency in the guinea pig is an arthropathy typified by pain and swelling of the periarticular tissues.

Rinehart and his coworkers<sup>5</sup> have also reported that the ascorbic-acid level of the blood plasma during fasting is almost uniformly and severely lowered in rheumatoid and rheumatoid types of arthritis. He theorized a "fundamental fault in vitamin-C metabolism" and noted that the administration of generous supplements of vitamin C failed to increase the plasma levels materially, although the urinary excretion might be relatively high. A lowered renal threshold was suggested as a possible mechanism.

A group of forty-eight cases of rheumatoid arthritis was studied at the George F. Geisinger Memorial Hospital in Danville, Pennsylvania. Each patient presented fusiform joint swelling, muscle atrophy, increased sedimentation rate, hypochromic anaemia, and the other criteria usually associated with rheumatoid arthritis. The fasting content of ascorbic acid of the blood plasma was determined, using the method proposed by Farmer and Abt.<sup>2</sup> Rinehart, Greenberg, and Baker<sup>5</sup> have reported that levels ranging between seven-tenths and nine-tenths of a milligram per 100 milliliters of blood are adequate, while levels below seven-tenths of a milligram are suboptimal, and those below five-tenths of a milligram are definitely low. The work of Wortis, Liebmann, and Wortis<sup>8</sup> substanti-

ates the validity of the blood level as an accurate guide to the clinical needs of the individual in relation to vitamin C.

Of the forty-eight patients studied, only one showed an initial ascorbic-acid level of the blood plasma in excess of seven-tenths of a milligram. This patient was of a robust, sthenic type and did not reveal the emaciation and malnutrition usually found in arthritics of the rheumatoid type. The remaining forty-seven patients showed initial ascorbic-acid levels of the blood plasma ranging from thirty-seven hundredths to sixty-eight hundredths of a milligram per 100 milliliters of blood with an average of forty-two hundredths of a milligram.

These forty-seven patients were given 100 milligrams of an injectable form of ascorbic acid daily for one week, and were then given 300 milligrams of ascorbic acid daily by mouth. Forty-five of these patients showed an immediate response: in more than one-half the ascorbic-acid level of the blood plasma reached eight-tenths of a milligram or more at the end of the week of intravenous therapy, and in all forty-five a plasma level of one milligram or more was reached at the end of the second week of oral therapy. The remaining two patients did not respond to therapy and retained blood levels below six-tenths of a milligram.

The forty-five patients were followed for periods varying from three weeks to six months, during which time they continued to take 300 milligrams of ascorbic acid orally per day. All retained normal ascorbic-acid levels of the blood plasma. Repeated sedimentation rates were obtained in eighteen of the forty-five cases. There was no significant change, all retaining their elevated rates. The patients' clinical course showed the usual periods of remission, but with no striking joint changes. The degree of joint swelling was not notably affected. All reported increased appetite and slight gains in weight, ranging from one to five pounds. At the end of the period of observation, approximately 20 per cent. were moderately improved, 33 per cent. were slightly improved, and 47 per cent. showed no change or were worse (Table I).

TABLE I

RESULTS IN FORTY-FIVE CASES OF RHEUMATOID ARTHRITIS  
FOLLOWING THE ADMINISTRATION OF ASCORBIC ACID PARENTERALLY AND ORALLY

No. of Cases	Initial Ascorbic-Acid Level of Blood Plasma (Milligrams)	Final Ascorbic-Acid Level of Blood Plasma (Milligrams)	Clinical Result		
			Moderately Improved (Cases)	Slightly Improved (Cases)	Unchanged (Cases)
12	0.6 to 0.68	1.2 to 1.9	5	7	0
17	0.5 to 0.6	1.3 to 1.7	3	4	10
16	0.37 to 0.5	1.1 to 1.6	1	4	11
45			9	15	21

Eighteen of twenty patients with hypertrophic arthritis simultaneously studied showed ascorbic-acid levels of the blood plasma in excess of seven-tenths of a milligram with an average of ninety-two hundredths of a milligram per 100 milliliters of blood.

#### SUMMARY AND CONCLUSIONS

The ascorbic-acid level of the blood plasma in active cases of rheumatoid arthritis is regularly low.

With the use of adequate amounts of ascorbic acid, orally and parenterally, it is readily possible to raise the plasma level to within normal limits.

There is no marked clinical response, even though the plasma level has been returned to normal.

The low ascorbic-acid content of the blood plasma present in active cases of rheumatoid arthritis is probably a reflection of the general state of malnutrition and has no etiological significance.

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# OSTEOCHONDRITIS DISSECANANS OF THE HIP

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Osteochondritis dissecans is a non-infectious aseptic necrosis of a segment of subchondral bone of the long bones of the extremities, resulting ultimately, although not invariably, in an osseocartilaginous sequestrum into the affected joint. It occurs primarily in males in the second decade of life. The medial femoral condyle is the most frequent site of involvement, the capitellum being the next most frequent. Twenty per cent. of the cases are bilateral.

In 1932, one of us (D. K.) reported twenty-four such cases (knee, twenty; elbow, four). At that time we had not seen this interesting lesion in the hip joint. Since then, however, we have observed two such cases, a report of which is the primary purpose of this article.

## HISTORY

The first reference in the literature to osteochondritis dissecans of the hip joint occurred in 1925, in an article by Haenisch. Richards, in 1928, in discussing the roentgenographic picture of osteochondritis dissecans, included in his article the case report of a young man suffering from involvement of the hip. Richards's patient was also the first to be subjected to surgical intervention, apparently with a favorable result. During the year 1929, additional cases reported by Bergmann, Galdau, and Lange established without doubt the reality of osteochondritis dissecans of the hip joint, bringing the total number of cases reported to six. In 1930, Gold added the seventh and eighth cases, and one year later Magnin reviewed and clarified the entire literature up to that time. Magnin concluded: "König's disease actually exists in the hip joint. We have assembled five cases, two of which have been verified by surgical intervention. The lesion is often bilateral. It should be sought for systematically in every case of chronic arthritis of the hip joint, for proper treatment may obviate functional destruction of the joint and ankylosis." On the basis of only two operative cases—his own and that of Bergmann—he stated that "the therapy to be employed is arthrotomy with ablation of the sequestrum", and cautioned that "the similarity between the names of osteochondritis dissecans of the hip and osteochondritis juvenilis, Calvé-Perthes disease, can only result in a regrettable confusion. No relationship between these two exists, and the evolution and treatment of the two affections are entirely dissimilar."

Since this excellent thesis by Magnin, several case reports have appeared in the literature. Table I is a brief summary of the reported

TABLE I

SUMMARY OF CASES OF OSTEOCHONDritis DISSEANS OF THE HIP REPORTED IN THE LITERATURE

Authors	Year	No. of Cases	Age (Years)	Sex	Symptoms	Duration	Past History	Signs	X-Ray Findings	Treatment	Result	Observation Period	Comment
Huenisch	1925	1	30	Male	Pain in left hip, worse on motion or fatigue	3 years	Negative	None	Typical osteochondritis dissecans of left hip	Conservative	?	?	First reported case
Richards	1928	1	16	Male	Pain in right hip	2 years	Trauma	Abduction limited and painful	Typical osteochondritis dissecans of right hip	Surgical ablation	?	?	First case operated on
Borgmann	1929	1	24	Male	Pain in left knee and hip Hip seemed to "lock"	2 months	Negative	Left limp, coxalgia, motion painful	Typical osteochondritis dissecans of left hip	Surgical ablation	Excellent	8 weeks	Lesion on anterior inferior surface of femoral head
Lange	1929	2	17	Male	Pain in right hip, worse on motion	3 months	Trauma	Atrophy and limitation of abduction	Bilateral osteochondritis dissecans of hip	Conservative	No improvement	5 months	Changes in other bones seen in x-ray
			22	Male	Pain in left hip, worse on motion	6 years	Negative	Atrophy, left limp, decreased rotary motion	Osteochondritis dissecans of left hip	Conservative	No improvement	8 years	X-rays on final examination show osteochondritis dissecans of right hip and secondary anaemia of left hip
Galdau	1929	1	26	Male	Pain in left hip, causing patient to be bedridden for several weeks at a time	4 years	Negative	Pain on extreme abduction	Typical osteochondritis dissecans of left hip	Conservative	No improvement	2 years±	Skin incision made to see if patient was malingering
Gold	1930	2	16	Male	Pain in left knee	6 months	Negative	Limitation of abduction and of hyperextension	Bilateral osteochondritis dissecans of hip	Conservative	Arthritis developing	2¼ years	
			13	Male	Pain in left hip	1½ years	Negative	None	Osteochondritis dissecans of left hip	Conservative	Spontaneous healing	3½ years	Probably a case of Caivé-Perthes disease



Magnin	1931	1	32	Male	Pain in both hips Inability to walk	{ Left, 2 years Right, 1 year 3 months	Negative	Typical bilateral malum coxae se- nilis	Bilateral osteochon- dritis dissecans of hip	Bilateral sur- gical abla- tion	Excellent on right Arthritis on left	2½ years	Anatomical resti- tution
Franchillon	1932	3	14	Male	Pain in left hip on exertion	Several years	Negative	Left limp and slight limitation of ab- duction	Osteochondritis dis- secans of left hip	Conservative	No improvement	9½ years	X-ray unchanged
			23	Male	Pain in both hips, worse on motion	½ year	Negative	Slight right limp	Bilateral osteochon- dritis dissecans of hip	Conservative	?	?	
			23	Male	Pain in both hips, worse on motion	10 years	Negative	Slight right limp	Bilateral osteochon- dritis dissecans of hip	Conservative	?	?	2 fragments on right
	1932	1	51	Male	Pain in left hip, "catching" in type	3 years	Negative	Slight limitation of all movements	Typical osteochon- dritis dissecans of left hip	Surgical abla- tion	Excellent	1 year	
Moutonguet	1932	2 (but only 1 new case)	32	Male									Same case re- ported by Mag- nin in 1931 (see above)
Müller			27	Male	Pain in left hip, worse on motion	6 years	Negative	Limitation of hy- perextension	Osteochondritis dis- secans of left hip	Surgical abla- tion	Excellent	20 months	Anatomical resti- tution
	1933	1	14	Male	Pain in both hips and elbows, worse on motion	Several months	Negative	None in hips	Osteochondritis dis- secans of hips, el- bows, and knees	Conservative	?	?	X-ray not typical
	1933	1	24	Male	Pain in right hip	5 years	Negative	Slight right limp and limitation of flexion, abduc- tion, and internal rotation	Osteochondritis dis- secans of right hip	Surgical abla- tion	Walks well, but suffers some pain after pro- longed exercise	5½ months	Article not avail- able to us

TABLE I (Continued)

Authors	Year	No. of Cases	Age (Years)	Sex	Symptoms	Duration	Past History	Signs	X-Ray Findings	Treatment	Result	Observation Period	Comment
Müller and Hetzar	1933	3	26	Male	Pain in hips, knees, and elbows	14 years	Negative	Limitation of motion in hips, knees, and elbows	Arthritis of hips	Conservative	?	?	
			20	Male	Pain in hips, knees, and elbows	{ Right hip, 8 years Left hip, 5 years	Negative	Limitation of motion in hips, knees, and elbows	Arthritis of hips	Conservative	?	?	X-ray not diagnostic for hip in any case
			12	Female	Pain in hips and spine	1½ years	Negative	Limitation of motion in hips	Osteochondritis dissecans of hips	Conservative	?	?	All cases in one family
Stören	1934	1	27	Male	Pain in left hip, worse on motion	17 years	Negative	Limitation of motion in hips and knees	Osteochondritis dissecans of right hip and both knees Arthritis of left hip	Conservative	?	?	Family history of osteochondritis dissecans, also of multiple-joint involvement
Mouchet	1935	1	48	Male	Pain in right hip, worse on motion	1 year	Negative	Bilateral early malum coxae senilis	Osteochondritis dissecans of right hip Arthritis of left hip	Surgical ablation advised	?	?	
Schörcher	1937	4	31	Male	Pain in left hip and knee	6 years	Negative	Limitation of motion, especially abduction	Osteochondritis dissecans of left hip with secondary arthritis	Conservative	?	?	
			27	Male	Pain in left hip and knee	15 years	Negative	Slight limp and limitation of abduction and rotation	Osteochondritis dissecans of left hip	Conservative	?	?	
			18	Male	Sudden pain in left hip		Trauma	None	Osteochondritis dissecans of left hip	Conservative	?	?	
			49	Male	Pain in right hip	19 years	Negative	Limp and inversion of limb	Osteochondritis dissecans of right hip	Conservative	?	?	
Dussaut	1938	1	?	Male	Pain in left hip	5 years	Negative	Slight limp	Osteochondritis dissecans of left hip complicated by arthritis deformans	Costal-graft arthrodesis	Good	1 year	Article not available to us

TABLE 1 (Continued)

Authors	Year	No. of Cases	Age (Years)	Sex	Symptoms	Duration	Past History	Signs	X-Ray Findings	Treatment	Result	Observation Period	Comment
Müller and Hietzar	1933	3	26	Male	Pain in hips, knees, and elbows	14 years	Negative	Limitation of motion in hips, knees, and elbows	Arthritis of hips	Conservative	?	?	X-ray not diagnostic for hip in any case. All cases in one family
			20	Male	Pain in hips, knees, and elbows	Right hip, 8 years Left hip, 5 years	Negative	Limitation of motion in hips, knees, and elbows	Arthritis of hips	Conservative	?	?	
			12	Female	Pain in hips and spine	1½ years	Negative	Limitation of motion in hips	Osteochondritis dissecans of hips	Conservative	?	?	
Stören	1934	1	27	Male	Pain in left hip, worse on motion	17 years	Negative	Limitation of motion in hips and knees	Osteochondritis dissecans of right hip and both knees Arthritis of left hip	Conservative	?	?	Family history of osteochondritis dissecans, also of multiple-joint involvement
Mouchet	1935	1	48	Male	Pain in right hip, worse on motion	1 year	Negative	Bilateral early malum coxae senilis	Osteochondritis dissecans of right hip Arthritis of left hip	Surgical ablation advised	?	?	
Schörcher	1937	4	31	Male	Pain in left hip and knee	6 years	Negative	Limitation of motion, especially abduction	Osteochondritis dissecans of left hip with secondary arthritis	Conservative	?	?	
			27	Male	Pain in left hip and knee	15 years	Negative	Slight limp and limitation of abduction and rotation	Osteochondritis dissecans of left hip	Conservative	?	?	
			18	Male	Sudden pain in left hip		Trauma	None	Osteochondritis dissecans of left hip	Conservative	?	?	
Dussaut	1938	1	49	Male	Pain in right hip	19 years	Negative	Limp and inversion of limb	Osteochondritis dissecans of right hip	Conservative	?	?	
			?	Male	Pain in left hip	5 years	Negative	Slight limp	Osteochondritis dissecans of left hip complicated by arthritis deformans	Costal-graft arthrodesis	Good	1 year	Article not available to us

Further roentgenograms localized the osteochondritic focus to the upper portion of the superolateral quadrant of the femoral head, midway between the insertion of the capsule and the insertion of the ligamentum teres.

Accordingly, an exploration of the hip joint through an anterior approach was done on August 27, 1933. The capsule of the joint was opened; the femoral head was inspected, and no abnormalities could be detected in the articular cartilage exposed. It was felt that it was wiser not to dislocate the femoral head, and the wound was closed without complete inspection of the femoral head.

The patient made an uneventful postoperative recovery, and was dismissed from the hospital on September 8, 1933. However, she did not benefit in the least from the

operation. On arising, or on leaning over, the hip grated and felt sore, and pain and limp appeared after moderate movement or weight-bearing.

Examination on September 1, 1939, revealed a slight limp on weight-bearing. The legs were of equal length; moderate atrophy was present in the left thigh muscles, and extreme flexion was slightly painful.

Check-up roentgenograms showed the right hip to be normal. The osteochondritic focus was still present in the left femoral head, and there was some flattening of the head, with small areas of decreased density surrounding the button of bone (Figs. 2-A and 2-B).

Reexploration of the left hip joint was effected on September 8, 1939, using the Smith-Petersen approach. The thickened scarred capsule was



FIG. 1

Case 1. Before first operation.

opened; the hip was rotated as completely as possible within the acetabulum, and in no position could the osteochondritic focus be seen. Accordingly, the femoral head was dislocated by flexion, adduction, and forcible external rotation of the thigh. The ruptured ligamentum teres bled considerably, especially from the femoral end. On the superolateral aspect of the femoral head the osteochondritic focus was readily identified (Figs. 3-A and 3-B). It was roughly elliptical, two by two and five-tenths centimeters in diameter, covered with normal articular cartilage, and clearly demarcated from the adjacent head by a furrowing and imbrication of the surrounding cartilage. The focus dipped on pressure. No evidence of arthritis was present. The osteochondritic focus was removed by incising along the cartilaginous groove, and the avascular fibrous-tissue bed was curetted before bleeding occurred (Fig. 3-C). The dislocation of the femoral head was reduced, the joint capsule was closed, and the wound was approximated in layers. A walking hip spica cast was applied.

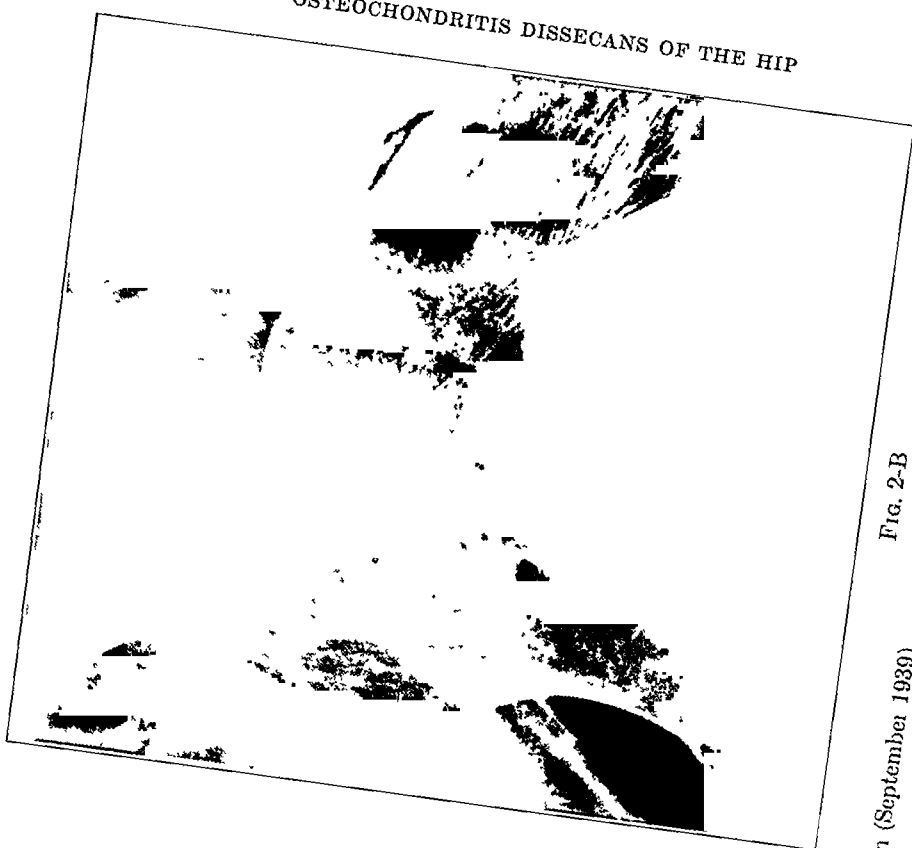


Fig. 2-B

Case 1. Before second operation (September 1939).



Fig. 2-A

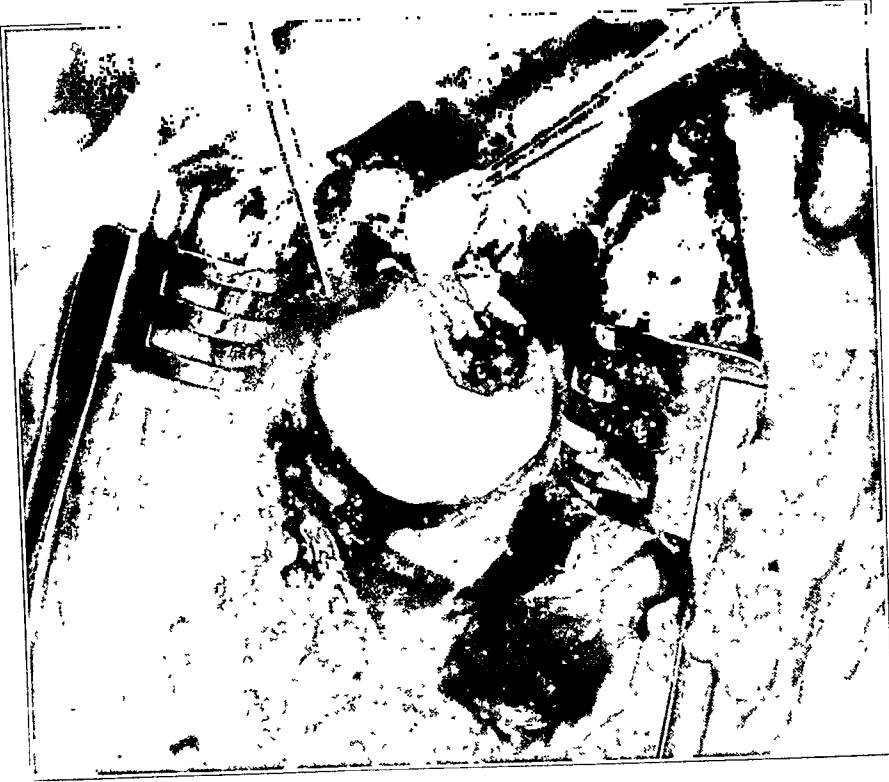


FIG. 3-B

Case 1. The osteochondritic focus has been reflected upward by incising along the cartilaginous grooving except superiorly. The clamp remains on the ligamentum teres; the forceps hold the osteochondritic fragment.



FIG. 3-A

Case 1. The femoral head has been luxated from the acetabulum. The clamp is on the ligamentum teres. On the superolateral aspect of the femoral head the osteochondritic focus is readily visible. Note the furrowing and imbrication of the surrounding cartilage.

The patient's post-operative course was uneventful. She was up and walking in the hip spica cast by the tenth day. A full range of painless motion was established within three weeks' time. (See Figures 7-A and 7-B.)

CASE 2. E. G., male, thirty-three years old, an Italian truck driver, entered the hospital on May 28, 1939, complaining of pain in the left hip. For the past ten years he had been having mild pain in the left hip, particularly noticeable on arising from a sitting or a lying position, or after walking for any length of time. A slight limp, which accompanied the pain, disappeared on limbering up the joint, and reappeared on fatigue. Ten days before entry, the patient had had an attack of acute pain in the left hip; he was unable to flex the thigh actively, and walked with the hip in internal rotation, for external rotation seemed to "lock" the hip. After seven or eight days of bed rest, the hip had again returned to its former status. There was no history of trauma, and no other joints were involved.

The general physical examination was negative. The legs were of equal length, and the gait was normal. No atrophy was present. Flexion was slightly restricted; remaining movements were normal. There were no signs of inflammation about the joint.

No definite clinical diagnosis could be made. Roentgenograms (Figs. 8-A and 8-B) showed the typical lesion of osteochondritis dissecans on the superolateral surface of the left femoral head. The right femoral head was normal.

Exploration was effected on May 29, 1939, by means of a Smith-Petersen approach. The iliofemoral ligament was incised, and the visible portion of the articular surface of the femoral head was inspected. No abnormality could be detected. The femoral head was then dislocated by flexion, adduction, and forcible external rotation of the limb. The ruptured ligamentum teres bled moderately from the severed ends. On the superolateral aspect of the femoral head an irregular rhomboidal grooving in the articular cartilage, roughly two by three centimeters, was readily seen (Fig. 9). The cartilage within this clearly delineated groove appeared normal, but, on pressing upon this area with the back of a knife, it was found that this segment of cartilage and the underlying bone gave way. The "dissected" portion of bone, so clearly visible in the roentgenogram, was, therefore, found only after dislocating the head of the femur. The osteochondritic focus was then removed by incising along the cartilaginous groove. No bleeding was encountered in removing this segment. The bone fragment was, in fact, dead, and was separated from the underlying healthy bone by a sheath of avascular fibrous tissue. As soon as the



FIG. 3-C

Case 1. The osteochondritic focus has been removed. The avascular fibrous-tissue bed is seen. The clamp is on the ligamentum teres.



FIG. 6

Case 1. Section through the ligamentum teres, showing the caliber of the blood vessels present.

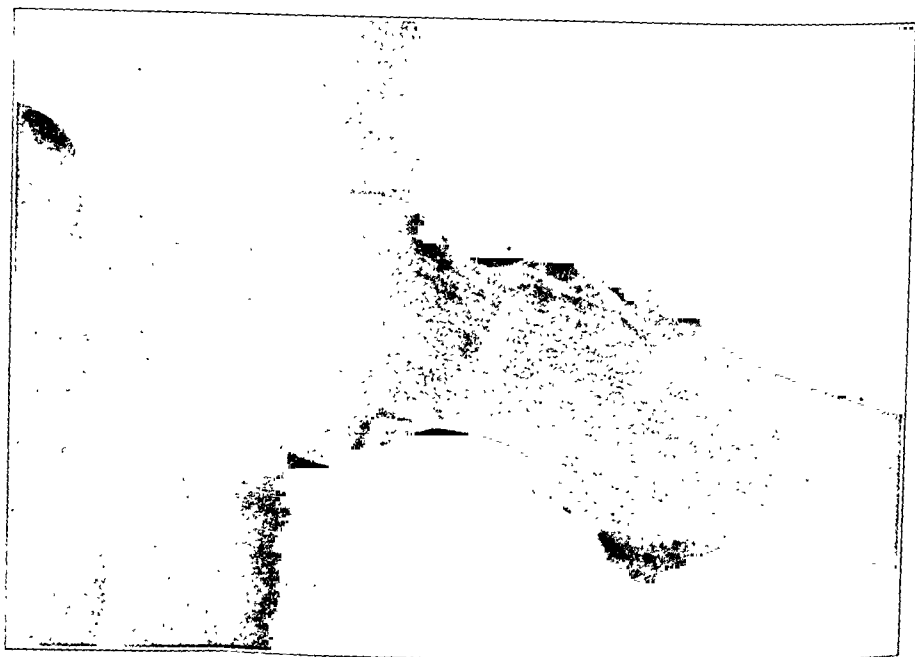


FIG. 7-A

Case 1. Postoperative check-up roentgenogram, three weeks after operation.



## GENERAL FINDINGS

Osteochondritis dissecans of the hip is a non-infectious aseptic necrosis of a segment of subchondral bone on the superolateral aspect of the femoral head. It is bilateral in from 30 to 35 per cent. of the cases.

*Age*

Most of the cases fall into the age group between sixteen and thirty-two years. A case in which the patient was as young as twelve years has been reported, and the oldest known patient is fifty-one. The average age is twenty-five.

*Sex*

Twenty-five cases have been reported in males. We are adding the twenty-sixth and the second case in a female.

*Duration of Symptoms*

The average duration of symptoms prior to seeking treatment was six and three-fourths years. The shortest duration was two months; the longest, nineteen years. It is a chronic joint affection.

## SYMPTOMATOLOGY

There are no characteristic symptoms. According to most authors there are three definite stages in the symptomatology and course of this affection, each phase being very variable. These phases are: (1) latent, (2) painful, and (3) ankylosing.

*Latent Phase*

Symptoms are usually entirely absent. There may be short attacks of fleeting pain in the hips or knees with transient limitation of motion.



FIG. 7-B

Case 1. Postoperative check-up roentgenogram, three weeks after operation.

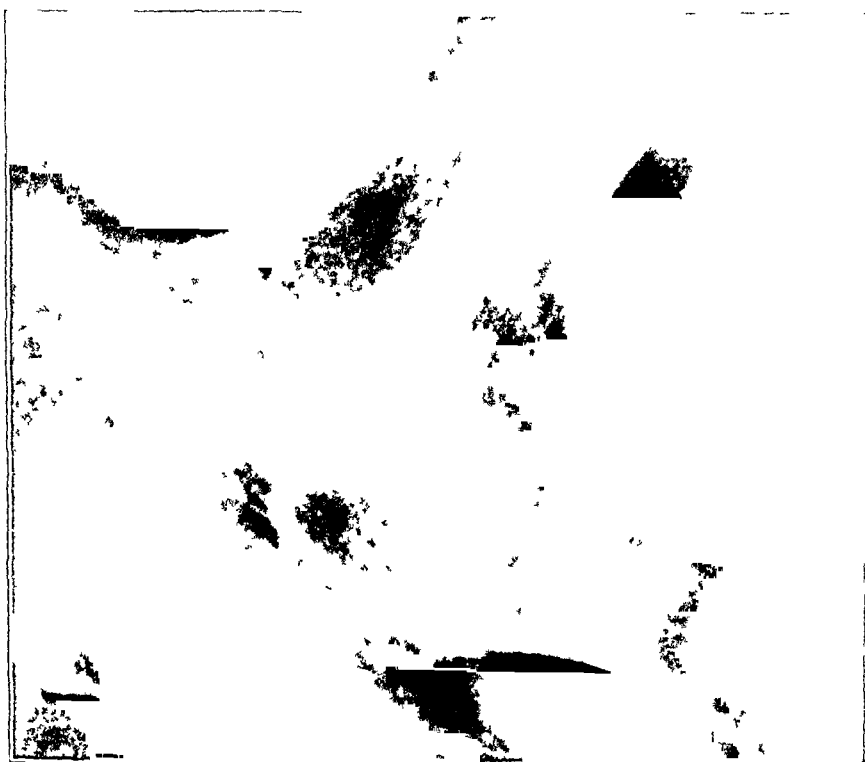


Fig 8-B



Fig 8-A

Case 2 Preoperative roentgenograms.



FIG. 9

FIG. 9  
Case 2. At operation. The femoral head has been dislocated from the acetabulum. The osteochondritic focus has been reflected downward and is held in place by forceps. The clamp is on the ligamentum teres.

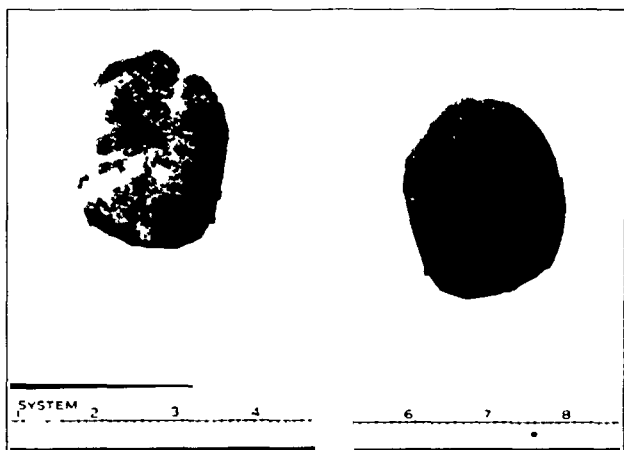


FIG. 10-A

FIG. 10-A

Case 2. Photographs of removed fragment (actual size): at left, deep surface; at right, superficial surface.

FIG. 10-B

Case 2. Roentgenograms of fragment removed. Note that there are two main osseous fragments.

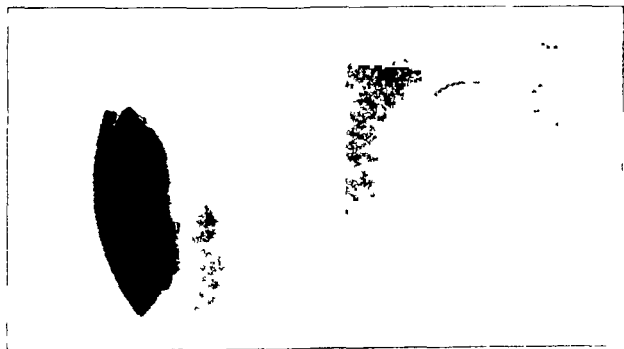


FIG. 10-B

The existence of this phase was proved by finding bilateral lesions in patients complaining of pain in only one hip (Lange).

### *Painful Phase*

This is characterized by a gradual onset of mild, intermittent, but constant, pain in the hip or the knee. The pain varies in degree and in severity in the same individual as well as in different individuals. The pain is apparently mechanical in origin, for it is aggravated by motion or by fatigue, it disappears on resting, and it reappears after immobility until the hip is "limbered up". The pain may radiate to the knee, the inguinal region, or the gluteal regions. Accompanying dragging of the leg or limping is very frequent, and moderate to mild limitation of motion occurs. For various motions the hip seems "locked", but no true locking is possible (see Pathology), and the symptoms are entirely due to pain and muscle spasm. The pain and functional impairment may attain such severity as to render the patient bed-fast or to oblige him to walk with the aid of canes.

### *Ankylosing Phase*

This phase should preferably be called the arthritic phase, for no true cases of ankylosis—either bony or fibrous—have occurred. The picture is one of typical *malum coxae senilis*,—a chronically painful hip, limping, moderate to severe impairment of motion, and marked functional disturbances. This picture is seen in the older patients in the age group between thirty-five and fifty.

## CLINICAL EXAMINATION

There are no signs pathognomonic of this disease.

### *Latent Phase*

Signs are usually absent. There may be a mild restriction of motion, usually of hyperextension, abduction, or external rotation.

### *Painful Phase*

The gait is usually of the coxalgic type. Mild atrophy of the thigh or of the gluteal muscles may be apparent. Tenderness, abnormalities in anatomical landmarks, shortening, and evidence of inflammation are invariably absent. Active and passive motions are restricted—active more than passive—and the extremes of motion are painful. Abduction, hyperextension, and external rotation are chiefly affected, and flexion is usually quite well preserved.

### *Ankylosing or Arthritic Phase*

The clinical picture is that of an early *malum coxae senilis*. The gait is coxalgic, the steps are short and hesitant, and the movements are limited and cautious. Mild atrophy is not infrequent. All movements of

the hip are limited,—the active more so than the passive. The leg flexes in abduction and in external rotation; and abduction, rotary movements, and hyperextension are almost entirely absent. All movements are painful and jerky. No true ankylosis has ever been demonstrated.

#### DIAGNOSIS

The diagnosis of osteochondritis dissecans of the hip can be made only by roentgenographic or surgical demonstration of the typical lesion. It should be suspected clinically in every young adult with a history of chronic pain in the hip and physical findings of limp or limitation of motion.

#### *Differential Diagnosis*

The roentgenographic appearance of osteochondritis dissecans of the femoral head is so absolutely and unmistakably characteristic and completely unlike that of any other pathological process as to make its diagnosis absolutely certain.

#### ROENTGENOGRAPHIC EXAMINATION

Osteochondritis dissecans of the hip joint may be diagnosed with certainty in the presence of a typical roentgenogram. Atypical roentgenograms are difficult to interpret, and the diagnosis of osteochondritis dissecans can be made only after surgical verification.

The typical location of the sequestrum is on the superolateral aspect of the articular cartilage of the femoral head above the round ligament. (One case only, reported by Bergmann, was on the anterior inferior quadrant.) The lesion is sharply defined and punched out, with well-marked borders. The osteochondritic focus is denser than the underlying femoral head, and rests directly upon it. The focus varies in thickness from two to nine millimeters and is rimmed with a sharp, clearly delineated, double-contoured margin, clearer than the subjacent femoral head. The entire femoral head is never involved; there is no flattening of the femoral head; and there are no changes in the femoral neck.

Later, as the disease progresses to the arthritic stage, the clearly demarcated focus disappears, and the changes of hypertrophic arthritis appear,—thinning of the joint space, mild flattening of the femoral head, crenation of the acetabular rim, and fine bony irregularities of the articular surfaces (Moulouguet and Lange).

In view of the high incidence of bilaterality, both hips must be examined roentgenographically. A few cases of multiple-joint involvement have been reported (Lange, Müller, Müller and Hetzar, and Stören). Roentgenograms of these joints should also be taken if symptoms referable to them exist.

There are no known accurate roentgenographic studies demonstrating the details of the transformation from the sequestered form to the arthritic form.

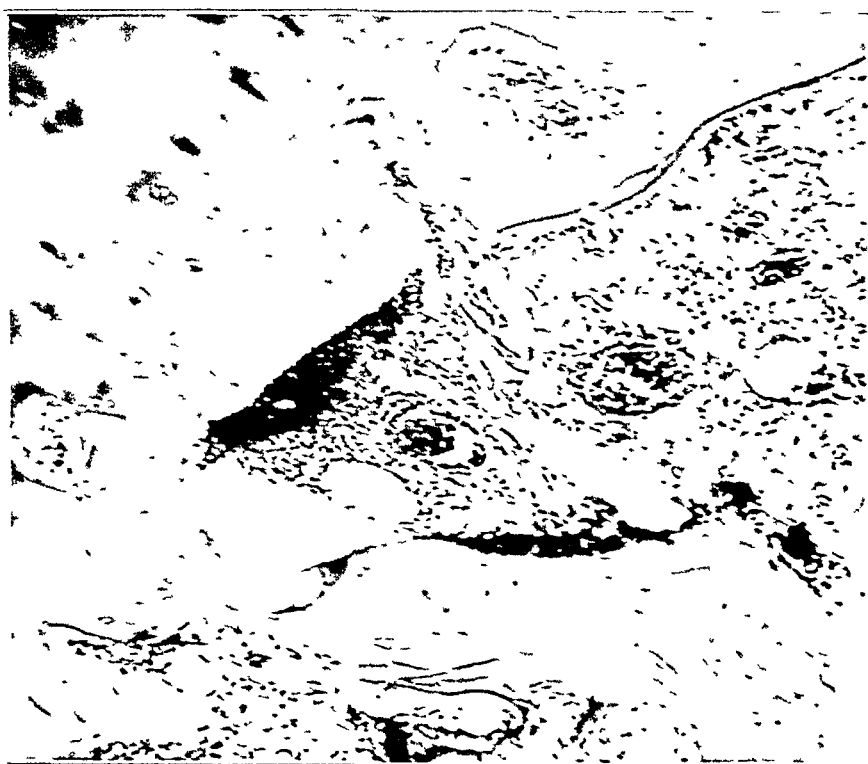


FIG. 11-B

Case 2. Details of junction of cartilage and bone. The lamellar structure of the bone is lost, the lacunae are empty, and marked fibrosis is present.

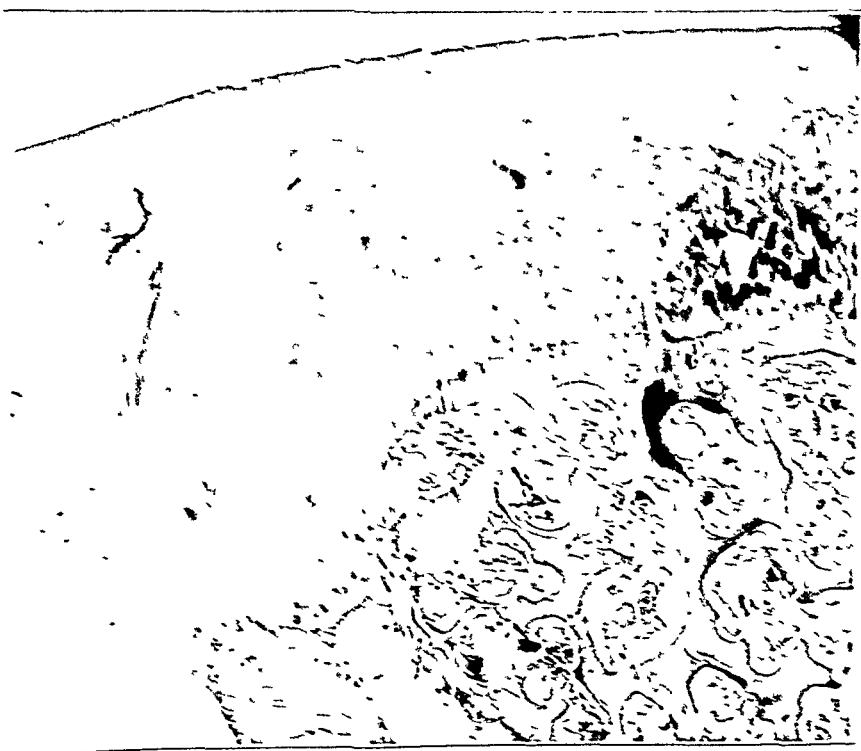


FIG. 11-A

Case 2. Photomicrograph of the osteochondral focus, showing the normal cartilage and the subjacent necrotic bone invaded by fibrous tissue.

## ETIOLOGY

The etiology of osteochondritis dissecans in the hip joint, as well as that of the disease elsewhere, remains obscure. The main theories expressed are: trauma, vascular disturbance of the femoral head, constitutional and familial factors, and atypical rheumatism. Tuberculosis and syphilis have been incriminated, but guinea-pig injections have given negative results, and manifestations of syphilis are usually absent.

## PATHOLOGY

*Gross*

In the hip joint the sequestered fragment is almost invariably covered by intact and normal articular cartilage. The cartilage on the periphery of the osteochondritic focus is furrowed and irregularly grooved. The subchondral bone is necrotic and separated from the underlying femoral head by a bloodless fibrous-tissue bed in which it lies securely. The synovial membrane in our cases was normal. The grooved cartilaginous area dips with pressure, but it is firmly attached to its osseous niche, and never forms a free chondro-osseous body in the hip joint. The size is usually one-half by three-quarters of an inch. (See Figures 4-A, 4-B, 10-A, and 10-B.)

*Microscopic*

The microscopic picture is identical with that of osteochondritis dissecans elsewhere. In brief, the overlying cartilage is normal, and the subjacent bone is necrotic with loss of lamellar structure. The osteochondritic bed is lined with non-inflammatory fibrocartilage. Foreign-body giant cells are present. The picture is one of necrosis with low-grade productive aseptic inflammatory response. (See Figures 5-A, 5-B, 11-A, and 11-B.)

## EVOLUTION

We have pointed out that, according to most observers, the disease in the hip may pass serially through three stages, the duration of which is very variable: (1) latent, (2) painful, and (3) arthritic. The shortest time recorded for this evolution is two months (Bergmann), but it frequently requires from ten to twenty years. It is by no means certain that all cases will progress serially through these stages, and the disease process may cease at the painful stage without resulting in arthritis.

Most observers feel that spontaneous healing does not occur. Gold, however, reports spontaneous healing in his second case, but it is possible that this case in a boy of thirteen might be an atypical Calvé-Perthes disease.

Free separation of the fragment is anatomically impossible.

## TREATMENT

The operative results for osteochondritis dissecans in the knee and elbow joints are good in 90 per cent. of the cases. In these cases, however,



Fig. 12-B

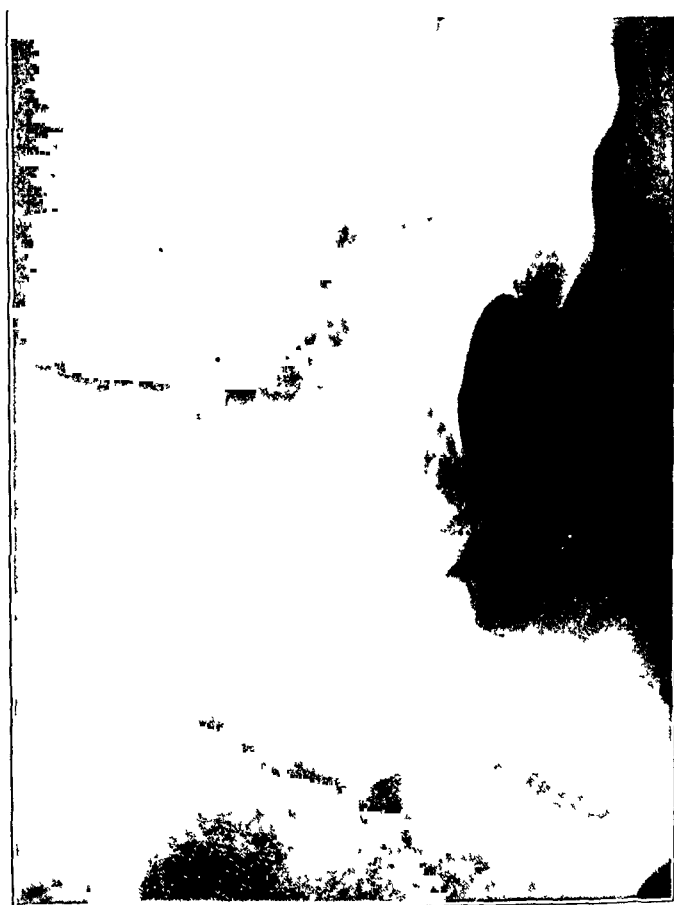


Fig. 12-A

Case 2 Postoperative roentgenograms, two months after operation.



the sequestration is more complete than in the hip joint, loose chondro-osseous bodies are not infrequently present, and their operative approach and removal are relatively simple. In view of the technical difficulties in exploring the hip joint and in locating these fragments, and considering the fact that most of the fragments are covered with normal articular cartilage, it is still questionable whether or not the sequestered fragment should be removed from the hip.

The lack of spontaneous healing, the chronic pain, the functional disturbances, and the possibility of ultimate progression to *malum coxae senilis* have encouraged several surgeons to remove the sequestered fragment. The available results are as follows:

<i>Surgeon</i>	<i>No. of Patients Operated Upon</i>	<i>Results</i>	<i>Postoperative Period</i>
Richards . . . . .	1	?	?
Bergmann . . . . .	1	Excellent	8 weeks
Magnin . . . . .	1 (Bilateral)	Right: Excellent Left: Arthritis	2½ years 2½ years
Mroz . . . . .	1	Excellent	1 year
Moulonguet . . . . .	1	Excellent	20 months
Valls and Ottolenghi . . . . .	1	Good	5½ months
Dussaut . . . . .	1	(Fused hip with costal graft)	?

Needless to say, these cases are insufficient both in the length of time after operation and in number to refute the arguments offered by the advocates of conservative therapy, namely: (1) Identification of the sequestered fragments necessitates luxation of the head of the femur, which destroys the ligamentum teres and favors later development of arthritis or aseptic necrosis of the femoral head; (2) there is no proof that ablation of the fragment prevents the later development of *malum coxae senilis*; and (3) ablation of the focus results in an altered femoral head, which mechanically should favor the development of traumatic arthritis.

Despite the controversial risk of favoring later arthritic or necrotic changes in the femoral head, surgery gives definite symptomatic relief, and may prevent the development of *malum coxae senilis*. It offers a chance for complete cure. Moulonguet reported almost complete anatomical restitution of the femoral head both in Magnin's case and in his own case after surgical ablation of the osteochondritic focus.

We wish to emphasize the necessity of luxating the femoral head in order to visualize and to remove the sequestered fragment properly. We have found the Smith-Petersen approach to the hip joint the most satisfactory.

#### SUMMARY

Osteochondritis dissecans is as distinct an entity in the hip as it is in the knee or in the elbow. Diagnosis can be made only by the roentgenographic appearance, which is characteristic. Dislocation of the femoral head from the acetabulum is necessary for proper visualization and re-



Fig. 12-B

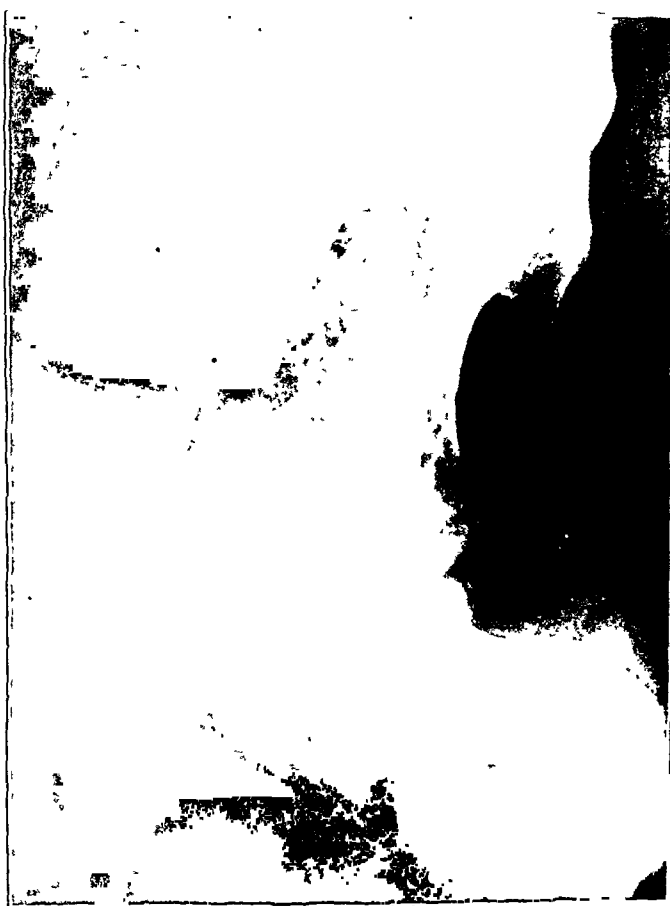


Fig. 12-A

Case 2. Postoperative roentgenograms, two months after operation.





Fig 12-B

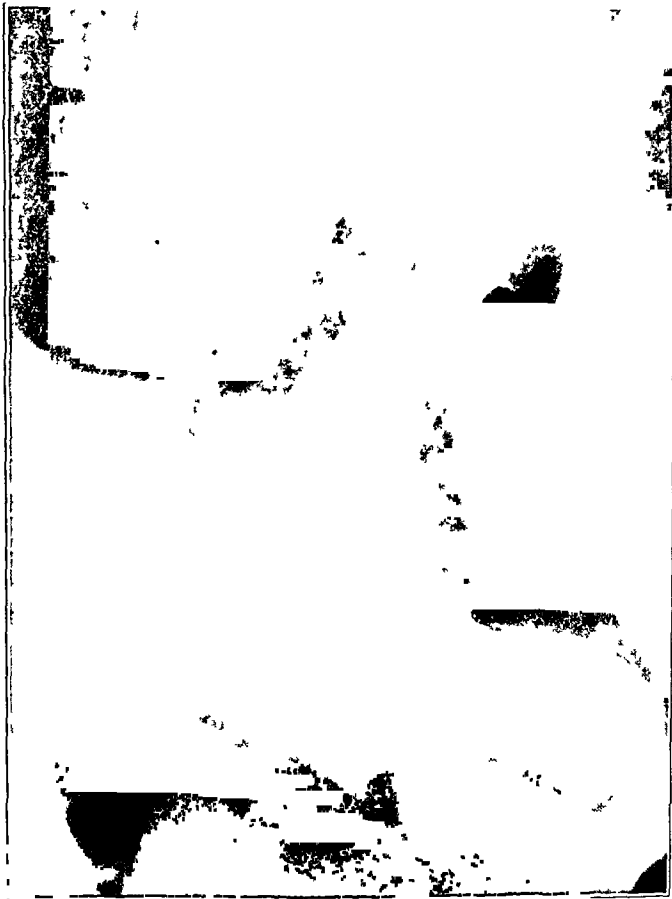


Fig. 12-A

Case 2. Postoperative roentgenograms, two months after operation

# DEFORMITY OF FIRST METATARSAL HEAD DUE TO FAULTY FOOT MECHANICS

BY LEO FREDERICK MILLER, M.D., AND JULIAN ARENDT, M.D.,  
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*From the Orthopaedic and Roentgenological Services of Mount Sinai Hospital, Chicago,  
and the University of Illinois, College of Medicine*

A series of three cases which revealed the effect of stress and strain upon the head of the first metatarsal caused the investigation of the pathology from a roentgenological standpoint. Many investigators have written upon the mechanics of the foot and its applied pathology, but we have been unable to find any description resembling the condition shown in the cases presented.

Morton, in his excellent book, "The Human Foot", has summarized completely the effect of a shortened first metatarsal. He states that the second metatarsal bears the burden of the force, and this, together with the defect in the length of the first metatarsal, causes the foot to roll inward. The sesamoids, which serve primarily as contact points, are in a more posterior position (toward the neck of the first metatarsal), and thus their relation to the second metatarsal would tend to cause the body weight to be concentrated upon the latter when the foot is used as a lever. When this occurs, Morton has repeatedly noticed that the second metatarsal becomes thickened, because of the added stress and strain. He has also noted a hypermobility of the first metatarsal segment, visualized in the roentgenogram between the first and second cuneiforms (Fig. 1).

From the roentgenographic study of the cases presented, we are impressed with the similarity of the pictures,—namely, the shifting of the sesamoids posteriorly, the deformity of the head, the various areas of increased and decreased density as seen in the head of the first metatarsal, and the relative lack of increased width of the shaft of the second metatarsal.

The histories of these patients reveal that they had had foot complaints for years with a relative lack of relief regardless of the type of treatment,—pads, arch supports, special shoes, etc. In each case the distress was bilateral, and no other joint pathology or history of trauma was elicited. All of the patients were in the fourth and fifth decades of life.

In the roentgenograms, the sesamoids, which play a primary protective rôle with relation to the head of the first metatarsal, are displaced posteriorly, thus losing their protective function. It is our assumption that, due to this loss, the sequence of the underlying pathology is: (1) repeated slight traumata and (2) the subsequent development of an aseptic

necrosis of the head of the first metatarsal. Since the subchondral portion of the bone is involved and the head is subjected to repeated stress and strain in a stage in which the bone is pliable, the head is molded to conform with the stress. In these three cases the pathological changes are strikingly similar.

In the first case roentgenographic examination of the left foot revealed a shortened first metatarsal with only a slight shift of the metatarsal sesamoids and with preservation of the bone structure. In the right foot, however, the first metatarsal was markedly shortened, and the sesamoids had shifted and were displaced more laterally and posteriorly. (See Figure 1.) The head of the first metatarsal in each foot showed spotted areas of decreased density and an irregularity of the cartilage with some spur formation in the proximal lateral portion of the first phalanx, but the configuration of the head was still intact. In the second case the pathology was similar (Fig. 2). The head of the first metatarsal was broadened and deformed, and the sesamoids, which were irregular and much larger, had shifted posteriorly. The contour of the articulating

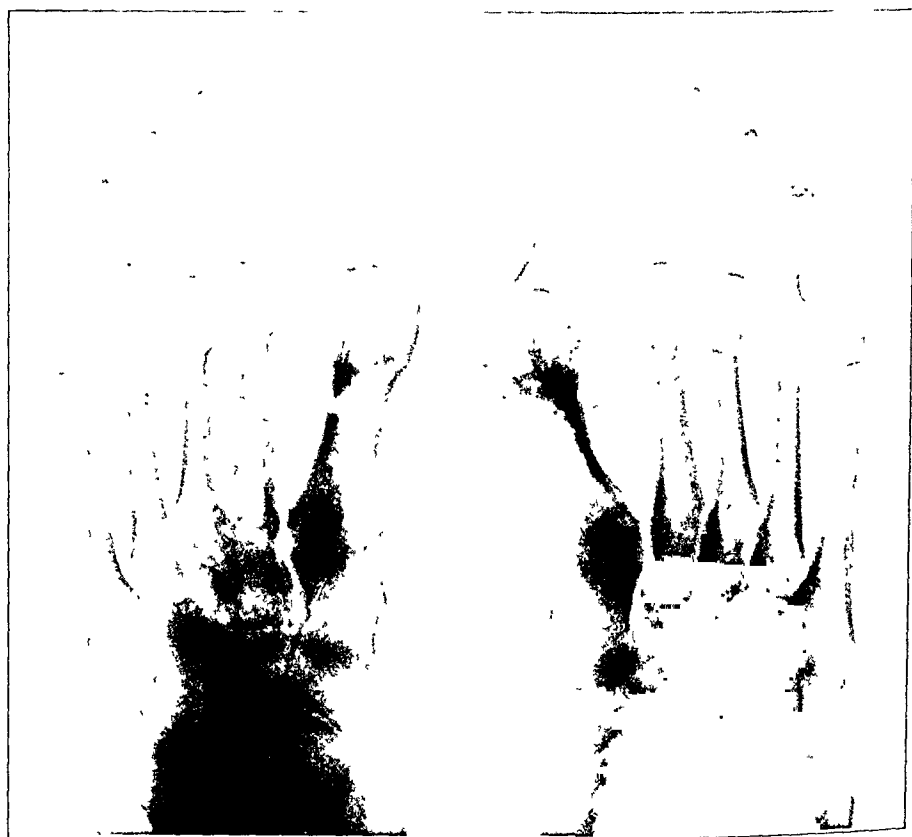


FIG. 1

The first metatarsal is shortened; the sesamoids are displaced laterally and posteriorly. The head reveals spotted areas of decreased density and irregularity of the cartilage with spur formation in the proximal lateral portion of the first phalanx, but the configuration of the head is still intact.



FIG. 2

The head is broadened and deformed, and there is shifting of the sesamoids posteriorly. The sesamoids are irregular and enlarged. The contour of the articular surface is wavy and irregular; the cartilaginous plate is thin. The right foot shows a subluxation. The shaft of the first metatarsal is thickened and elongated; the second metatarsal is normal. There is hypermobility of the first metatarsal segment.

surface was wavy and irregular, and there was thinning of the cartilaginous plate. The right foot showed a subluxation. The shaft of the first metatarsal was thickened and elongated, while the second metatarsal was normal. In this case the hypermobility of the first metatarsal segment, as described by Morton, was evident.

In the third case, roentgenograms (Fig. 3) showed the same marked thickness of the shaft of the first metatarsal, heavy trabeculae, spur formation, and subcapital sclerosis. The head of the first metatarsal was completely flattened, and the sesamoids on the right foot were displaced about in the middle of the shaft of the first metatarsal. Again there was noted the hypermobility of the first metatarsal segment with an apparently normal second metatarsal.

#### COMMENT

Normally, the metatarsal head is protected by the sesamoids, which are included in the capsule of the joint and are firmly inserted in the



FIG. 3

There is marked thickness of the shaft of the first metatarsal. Heavy trabeculation, spur formation, and subcapital sclerosis are present. The head is completely flattened. The sesamoids on the right foot are displaced about in the middle of the shaft of the first metatarsal. There is hypermobility of the first metatarsal segment; the second metatarsal is apparently normal.

tendon of the flexor hallucis brevis. Morton and Inge and Ferguson have shown definitely that the function of the sesamoids is: (1) to protect the flexor hallucis longus and (2) to protect the head of the first metatarsal and serve as a lift to the head, so that it will be slightly higher than the other metatarsal heads. Inge and Ferguson, in a series of forty-one cases, did not find any specific pathology in the sesamoid except bursitis, arthritis, and luxation. Such luxation, in our opinion, may occur frequently. This may be especially true when the first metatarsal is elongated. In two of our cases the first metatarsal was elongated, and the weight shift was to the first metatarsal segment and not to the second. The sesamoids then become more and more displaced and their protective character is lost, and, in our opinion, the term "sesamoid insufficiency" of Wisbrun explains the pathology which is due to repeated traumatism to the unprotected metatarsal head. The changes that occur are in no way different from those seen in other forms of aseptic necrosis. There are the same minute infarcts, the subcapital osteochondritis, and the collapse of the



articulating surfaces. In our first case, there was a shortened first metatarsal, but the mechanism of the weight shift to the second metatarsal segment, so ably described by Morton, was not present; instead, sesamoid insufficiency had caused a beginning aseptic necrosis of the head. Our second and third cases, in which the first metatarsal was elongated, were even more disposed to trauma and the changes were much more pronounced.

#### SUMMARY

These three cases reveal the complete development of metatarsal-head deformity due to (1) sesamoid insufficiency or (2) weight-bearing directly on the first metatarsal head with subsequent minute repeated traumata, resulting in an aseptic necrosis.

It is not within the scope of our paper to include the therapy, but, in our opinion, it is the logical conclusion that, when these cases are seen early, a protective mechanism should be applied to relieve strain and stress of dorsiflexion in the first metatarsal joint. The metatarsal bar would be of a distinct advantage, as in each of our cases a varying degree of hallux rigidus was present. Of these three patients, two have responded well to a shoe adjustment,—namely, the addition of a bar, one-quarter of an inch thick. In the remaining case, in which the hallux rigidus was so marked that regardless of the bar the patient still had distress, a bilateral partial phalangectomy of the proximal phalanx was performed, with definite improvement.

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## MULTIPLE FRACTURES

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Multiple fractures involving two or three extremities, plus fractures of the pelvis, the spine, the ribs, the skull, or the face, but without intra-abdominal lesions, will be considered in this report.

When one sees these cases, one is confronted with many problems in regard to the best methods of attack. In cases of multiple injuries, a special treatment for each lesion may be required, but it does not differ in principle from that employed in single fractures.

Our method of treating these patients is as follows: The patient, who is in shock of some degree, varying from the moderately severe to the extremely severe, is immediately given a hypodermic injection of H.M.C. No. 1 (one-hundredth of a grain of hyoscine, one-quarter of a grain of morphine sulphate, and caetane). No inhalation anaesthesia is needed or used. The hyoscine-morphine combination alone, or with the additional use of novocain infiltration, makes the procedures painless. We use this medication for all acute cases of trauma requiring surgery. Patients with fractures of the skull may be treated by this procedure. The patient is placed in shock position by elevation of the foot of the table. An intravenous injection of 1500 cubic centimeters of 5-per-cent. glucose-saline solution is given. Roentgenographic examinations are then made with a portable machine. The extremities are shaved without removing the temporary immobilization. One hour is allowed to elapse for the maximum effect of the hypodermic. With a trained team, treatment is instituted for all lesions. All compound wounds are thoroughly débrided. The fractures are then reduced and immobilized with their permanent fixation dressing, as required for the individual fracture and associated lesions. The patient is returned to bed, and the foot of the bed is elevated. A transfusion is given.

The immediate fixation of multiple fractures is necessary, and the shock and pain are controlled by medication and infusions. The earlier the fractures are reduced, the easier is this accomplished, and the more comfortable is the patient.

There is a marked reduction in the red cell count and in the hemoglobin in every case. This should be controlled by a transfusion within twenty-four hours, which is repeated as needed until the blood count is near normal limits.

Immobilization is maintained until complete osseous healing has occurred. Active muscle exercises of all non-immobilized joints and of all immobilized extremities are done hourly from the day of injury until the

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TABLE I

ANALYSIS OF THIRTY CASES OF MULTIPLE FRACTURES TREATED FROM JANUARY 1930 THROUGH DECEMBER 1938

Case No.	Sex	Age (Years)	Cause of Injury	Date of Injury	Fracture Sites	Treatment		Date	Follow-Up	
						Type	Date		End Result	
1	Male	26	Aeroplane crash	Mar. 2, 1930	Os calcis (bilateral) Left tibia and fibula (comminuted) Left radius (Dislocation of right 1st metatarsal)	Closed reduction	Mar. 5, 1930	June 5, 1933	Marked disability, with limitation of motion and pain in both feet	
2	Female	5	Automobile accident	July 17, 1931	Right femur Right radius and ulna (compound) Left clavicle	Skin traction	July 17, 1931		Patient died 2 days after admission	
3	Female	45	Fall from ladder	Oct. 22, 1931	Left humerus Left astragalus and lateral malleolus Os calcis (bilateral) Right 9th and 10th ribs	Closed reduction Open reduction	Oct. 22, 1931 Nov. 17, 1931	Oct. 20, 1932	Marked disability, with deformity and pain in both feet	
4	Male	50	Automobile accident	Nov. 4, 1932	Right and left tibiae and fibulae (compound) Left humerus (compound) Skull Ribs	Multiple pillow splints	Nov. 4, 1932		Patient died 12 hours after admission	
5	Male	54	Automobile accident	Feb. 19, 1934	Pelvis Right ribs Left tibia and fibula Right radius and ulna	Closed reduction	Feb. 21, 1934		Unknown	
6	Male	23	Automobile accident	Sept. 2, 1934	Skull Left mandible and maxilla (compound) Right femur (compound) Right tibia and fibula (Amputation of right 4th finger)	Skeletal traction  Bone graft in tibia	Sept. 2, 1934  Feb. 19, 1935	Jan. 9, 1936	Excellent function in all joints except knee, in which flexion was limited	
7	Female	80	Automobile accident	Oct. 14, 1934	Right humerus, radius, and ulna Right tibia and fibula Ribs	Closed reduction	Oct. 14, 1934		Unknown	
8	Female	22	Automobile accident	Oct. 21, 1934	Right and left humeri Left clavicle Pelvis, sternum, and ribs	Traction to arms and Bradford frame	Oct. 21, 1934		Unknown	
9	Male	19	Automobile accident	Nov. 16, 1934	Right tibia and fibula (compound) Left femur Pelvis	Morphine-sulphate injection	Nov. 16, 1934		Patient died 12 hours after admission	
10	Female	42	Automobile accident	Dec. 5, 1934	Skull Right and left radii (comminuted) Right femur (comminuted, supra-condylar)	Closed reduction	Dec. 5, 1934	Mar. 9, 1938	Marked disability	
11	Female	20	Automobile accident	Dec. 4, 1934	Pelvis Right and left tibiae and fibulae Left transverse process of 4th lumbar vertebra	Closed reduction Open reduction	Dec. 4, 1934 Dec. 10, 1934	Feb. 9, 1936	Normal motion	

TABLE I (Continue)

Case No.	Sex	Age (Years)	Cause of Injury	Date of Injury	Fracture Sites	Treatment		Follow-Up	
						Type	Date	Date	End Result
12	Male	62	Automobile accident	Dec. 18, 1934	Right humerus Left radius and ulna Right and left femora (intertrochanteric) Right patella Left tibia Left 1st metatarsal	Skin traction to right arm and forearm Skeletal traction to other fractures	Dec. 18, 1934 Dec. 18, 1934	Aug. 27, 1936	Motion in arms practically normal Limitation of abduction and internal rotation in both hips and of flexion of right knee Shortening of $\frac{1}{2}$ inch in left leg (See case report) Unknown
13	Female	19	Automobile accident	Dec. 30, 1934	Right humerus Right ribs (5th through 11th) Pelvis Right tibia (compound) Left fibula (Potts)	Skin traction to right arm Skeletal traction through right os calcis Amputation of right leg	Dec. 30, 1934 Dec. 30, 1934 Jan. 29, 1935		Unknown
14	Male	45	Automobile accident	July 27, 1935	Ribs Right and left femora (supracondylar) Right tibia	Skeletal traction	July 27, 1935		Unknown
15	Male	58	Automobile accident	Aug. 13, 1935	Skull Left radius Right and left tibiae and fibulae	Plaster immobilization	Aug. 13, 1935		Patient died $4\frac{1}{2}$ hours after admission
16	Male	39	Automobile accident	Nov. 30, 1935	Skull, superior maxilla (bilateral), nose, and left zygoma Ribs Left femoral head with dislocation Right tibial condyles	Closed reduction of tibial fractures Open reduction of femoral fracture and dislocation Open reduction	Dec. 2, 1935 Dec. 2, 1935	Jan. 8, 1938	Marked deformity and disability
17	Female	51	Automobile accident	May 16, 1936	Skull Right radius and ulna (compound) Left and right femora (compound, comminuted, supracondylar) Left fibula	Open reduction	May 16, 1936	Nov. 30, 1938	Motion practically normal Some instability in right knee (See case report)
18	Male	35	Motorcycle accident	June 5, 1936	Left radius and ulna (compound, comminuted) Left femur (compound, comminuted, supracondylar) Left tibia and fibula (compound, comminuted) Right tibia	Open reduction	June 5, 1936	Jan. 10, 1939	Complete function in left arm and right ankle Marked disability of left hip and knee
19	Male	74	Automobile accident	Dec. 4, 1936	Skull Left humerus (compound) Left metacarpals Left tibia (comminuted) Right tibia and fibula (compound)				Patient died two hours after admission
20	Female	43	Automobile accident	Dec. 10, 1936	Skull Left humerus Pelvis (General dislocation of left femoral head)	Closed reduction	Dec. 10, 1936		Unknown

21	Male	73	Fall from scaffold	Dec. 14, 1936	First lumbar vertebra Pelvis Right astragalus and navicular (comminuted) (Dislocation of left lunate)	Closed reduction	Dec. 14, 1938	Practically normal motion
22	Male	59	Automobile accident	May 7, 1937	Ribs Right tibia, fibula, and acetabulum Left radius Left patella (compound, comminuted) (Dislocation of right femur)	Closed reduction of all fractures except that of patella Open reduction of fracture of patella	May 7, 1937 May 7, 1937	Practically normal motion except in right hip where it was limited
23	Male	37	Automobile accident	May 28, 1937	Right femur (intertrochanteric) Right tibia and fibula (compound) Left tibia (compound) (Traumatic amputation of right foot)	Open reduction of fracture of left tibia Reamputation of right lower leg above fractures Immobilization of right femur	May 28, 1937 May 28, 1937 May 28, 1937	Amputation stump healed Right femur healing with some lateral angulation Left leg in plaster
24	Male	30	Automobile accident	June 16, 1937	Right and left radii and ulnae Left 1st metacarpal Left tibia and fibula	Closed reduction	June 16, 1937	Some limitation of motion in upper extremities
25	Male	68	Automobile accident	Dec. 10, 1937	Left scapula Left and right femora	Skeletal traction Beck drilling of left femur with graft	Dec. 10, 1937 July 8, 1938	Limitation of motion in left knee
26	Male	38	Automobile accident	May 1, 1938	Skull and right mandible Right and left tibiae and fibulae (compound, comminuted) Right radius and ulna (compound, comminuted) Right carpal navicular	Open reduction	May 1, 1938	Patient died 7 days after admission
27	Male	41	Aeroplane crash	Apr. 24, 1938	Left mandible (compound) Right and left tibiae and fibulae (compound) Left lateral tibial condyle Left ulna	Open reduction of compound fractures Closed reduction of other fracture	Apr. 24, 1938 Apr. 24, 1938	Complete function in left arm Some limitation of motion in legs (See case report) Patient died 2 1/2 hours after admission
28	Female	4	Automobile accident	Aug. 4, 1938	Skull Right and left femora (compound)	Open reduction of compound fractures and dislocation of elbow Closed reduction of dislocation of hip	Aug. 19, 1938	Patient still under treatment
29	Male	33	Fall from smokestack	Aug. 19, 1938	Left ribs Left radius and carpal bones (compound, comminuted) Left ulna (compound) All transverse processes of left lumbar vertebrae (Dislocation of right hip and compound dislocation of left elbow)	Open reduction of compound fractures and dislocation of elbow Closed reduction of dislocation of hip	Aug. 19, 1938 Aug. 19, 1938	Left elbow and wrist stiff Non-union of fractures of left radius Skull fracture (Hip fracture)
30	Male	32	Automobile accident	Nov. 15, 1938	Skull (compound) Right ribs (2nd through 6th) Right and left patellae (compound) Right radius, tibia, and fibula (compound)			

patient is discharged cured. By active use of the muscles, the muscle and tendon sense is maintained and joint stiffness and atrophy are prevented.

The mortality rate in this group is rather high. We treat every patient that is not moribund on admission as if he would recover. The patients that die within from one to twelve hours after admission are usually hopeless from the beginning.

There were twenty-nine patients \* with multiple injuries admitted to Nassau Hospital, Mineola, Long Island, from January 1930 through December 1938. Case 21 was treated at North Country Community Hospital, Glen Cove, Long Island. Table I gives the types and combinations of fractures which these patients presented, with the treatment and end results.

In the following three cases the treatment and end results are presented in some detail.

CASE 12. Male, aged sixty-two years, injured on December 18, 1934.

*Fracture Sites:* Right humerus, patella, femur (intertrochanteric); left radius, ulna, femur (intertrochanteric), tibia, and first metatarsal.

*Treatment:* Skin traction to right arm and forearm; wire traction through left radius and ulna (incorporated in plaster), right patella, and both femoral condyles; application of plaster boot to left foot; transfusion. All treatment was done within an hour of admission.

*End Result—August 27, 1936:* The right upper extremity was normal. The elbow and shoulder of the left upper extremity were normal. There was some dorsal bowing of the forearm; pronation was complete; supination was limited 50 per cent; the grip was fair; and the fingers and wrist were normal. In the left lower extremity, toe motion was fair; ankle motion was normal; the knee flexed to 90 degrees and extended to 180 degrees; flexion of the hip was normal; abduction and internal rotation were limited, but external rotation was normal. In the right lower extremity, toe motion was fair; ankle motion was almost normal; the knee flexed to 45 degrees and extended to 180 degrees; flexion of the hip was normal; abduction and internal rotation were limited, but external rotation was normal. There was one-half an inch of shortening of the left lower extremity. The patient complained of oedema of the legs after walking, but was able to go hunting and to walk three miles daily.

CASE 17. Female, aged fifty-one years, injured on May 16, 1936.

*Fracture Sites:* Skull; left femur (compound, comminuted, supracondylar), and fibula; right radius and ulna (compound); and femur (compound, comminuted, supracondylar).

*Treatment:* Débridement of all wounds under H.M.C. analgesia and novocain injection; wire traction through tubercles of both tibiae; intramedullary Steinmann pin through right olecranon into ulna; transfusions. All treatment was done on admission.

*End Result—November 30, 1938:* The right shoulder was normal; the elbow had complete flexion and extension; the forearm was held in pronation, and no supination was present; the wrist and fingers were normal. Both lower extremities appeared normal, except for some bowing of the right thigh. Motion in the hips was normal. Both knees showed complete extension and flexion to 120 degrees. The ankles were normal. The patient complained of some feeling of instability of the right knee. She was doing all her own housework.

CASE 27. Male, aged forty-one years, injured on April 24, 1938.

*Fracture Sites:* Left mandible (compound), tibia and fibula (compound), lateral tibial condyle, and ulna; right tibia and fibula (compound).

\* These patients were treated by Dr. W. L. Sneed, Dr. O. C. Hudson, Dr. W. P. Bartels, and Dr. J. C. Felicetti.

*Treatment:* Débridement and open reduction of the compound fractures with pin distraction incorporated in plaster; closed reduction of other fractures and aspiration of both knee joints. Treatment was done under H.M.C. analgesia and local novocain infiltration two hours after injury. Dr. John Mann immobilized the fracture of the mandible.

*End Result—February 7, 1939:* There was complete function in the left upper extremity. In the right lower extremity there was normal hip motion; the knee extended to 180 degrees and flexed to 90 degrees; the ankle dorsiflexed to a right angle; there was plantar flexion to 110 degrees, but no inversion or eversion. In the left lower extremity there was normal hip motion; the knee extended to 180 degrees and flexed to 110 degrees; the ankle dorsiflexed to a right angle; there was plantar flexion to 105 degrees, and slight inversion and eversion were present. Slight oedema was noted in both feet and legs. The gait was inelastic. The patient is still under treatment.

Table II gives the number of cases admitted from 1925 to 1938 in five-year periods with the mortality rate, and Table III shows the number of cases admitted per year during the period 1930 to 1938, with the number of deaths.

TABLE II  
NUMBER OF CASES AND DEATHS IN FIVE-YEAR PERIODS FROM 1925 TO 1938

Period	No. of Cases	No. of Patients Living	No. of Deaths	Percentage of Deaths
1925-1929 ..	3	2	1	33 33
1930-1934 .	13	10	3	23 07
1935-1938 .	17	12	5	29 41

In the period from 1925 through 1929 only the shock was treated, with temporary fixation of the fracture. The shock lasted from three to five days, and the patient was in continual pain from lack of adequate immobilization of the fractures. Then, when the patient's condition had

TABLE III  
NUMBER OF CASES AND DEATHS PER YEAR FROM 1930 TO 1938

Year	No. of Cases	No. of Patients Living	No. of Deaths
1930 . . . . .	1	1	0
1931 . . . . .	2	1	1
1932 . . . . .	1	0	1
1933 . . . . .	0	0	0
1934 . . . . .	9	8	1
1935 . . . . .	3	2	1
1936 . . . . .	5	4	1
1937 . . . . .	4	4	0
1938 . . . . .	5	2	3
Total . . . . .	30	22	8

improved, repeated attempts at reduction were necessary, with an increase in the permanent disability. In the period from 1930 through June 1934 patients were similarly treated with practically the same result.

In the period from July 1934 through December 1938 immediate fixation of the fractures was done. The patient was more comfortable, due to complete immobilization of the fractures; the shock was less; and the recovery from shock was shortened to twelve or twenty-four hours. The end results were better anatomically and functionally.

#### CONCLUSIONS

Multiple fractures should be treated the same as single fractures.

A trained team for each extremity is needed.

With the use of hyoscine-morphine analgesia, early treatment is possible without anaesthesia.

Transfusions should be given within twenty-four hours.

Treatment of the patients' injuries on admission, in addition to their general condition, secured better anatomical restoration of the extremities with improvement in the end results.



## CAVUS FEET \*

BY A. H. BREWSTER, M.D., AND C. B. LARSON, M.D.,  
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A study of the claw foot needs no introduction, since the problems involved are well known. In order to evaluate the commonly employed methods of treatment, we chose 200 cases from the files of The Children's Hospital, Boston, and asked the patients to report for examination. Only thirty-three responded, yet this comparatively small series, in which the postoperative period averaged seven and nine-tenths years, was quite representative of the entire group. The results of the follow-up were instructive enough to warrant this paper.

The etiology of claw-foot remains unsolved, but there are several aspects in the pathogenesis which may be stressed. In 1885, Shaffer noted that claw-foot developed in the wake of poliomyelitis where paralysis had been completely cured. Saunders estimated that in 40 per cent. of the poliomyelitis cases in 1931, in which there was transient paralysis, cavus feet developed in from three to twenty-four months after recovery. Steindler stated that cavus deformity is the expression of disturbed muscle balance, with a surplus of power in favor of the muscles which shorten and heighten the long arch—that is, the toe flexors and the peroneus longus—when unopposed by the gastrocnemius and the tibialis anterior. We found that, in cases of poliomyelitis with residual paralysis, cavus *per se* was indeed common, and occurred in association with any other conceivable deformity of the feet, and with no uniformity of the muscles involved.

Rocyn-Jones pointed out that cavus, when accompanied by an adaptive shortening of the plantar fascia, might be the result of continued faulty attitude, due to the weight of the bedclothes. We noted a cavus tendency in a high proportion of children who had been continuously in bed for six months or longer, even when the weight of the bedclothes had been removed. It would seem reasonable that gravity might play a rôle by allowing the forefoot to approximate the hindfoot, as occurs in both the supine and the prone positions.

The congenital theory was propounded by Gilroy, and, in support of it, Dane showed statistically that children up to two years of age have higher arches in proportion to the length of their feet than have adults. Congenital talipes equinovarus commonly has a difficult persistent cavus element. The so-called idiopathic cavus foot may belong to the congenital group.

Since the typical claw foot shows definite bone deformity, it must have developed during the growth period, and whether the bone deformity

\* Read at the Annual Meeting of the American Academy of Orthopaedic Surgeons, Boston, Massachusetts, on January 24, 1940.

TABLE I  
INCIDENCE OF RESIDUAL DEFORMITIES AND PAIN

	Feet Examined No.	Postoperative Residua			
		Cavus No.	Cocked-Up Toes No.	Callus No.	Pain No.
Group I . . . . .	11	11	12	10	6
Group II . . . . .	21	7	9	7	0
Group III . . . . .	9	2	0	4	3
Total . . . . .	41	20 (45%)	21* (48%)	21 (48%)	9 (20%)

\* In 14 of these cases the heel cords were tight,—2 to 45 degrees; in 10 of the remaining 23 cases in the entire group the heel cords were tight,—5 to 20 degrees.

is primary or secondary is purely a matter of viewpoint. Let us assume, for a moment, that at two years of age the destiny of any foot can be determined by the position of the os calcis,—that is, one with long leverage for the tendo achillis will eventually have a low arch and one with short leverage, a high arch. In relative degrees this is true. Now take the foot with short leverage for the tendo achillis and remove weight-bearing; in so doing the tendency to a cavus is enhanced. Further, if weight-bearing is disturbed by an absolute loss of muscle groups, or a loss of reciprocal muscle action in the foot, the cavus tendency again is present. This could explain the occurrence of cavus in association with poliomyelitis or Friedreich's ataxia on the basis of a surplus of power in favor of muscles which shorten and heighten the long arch.

With a continuation of the loss of weight-bearing, or a loss of muscle balance, growth is allowed in a cavus direction, and bone deformity results. The bone deformity consists of a U-shaped astragalus and an os calcis which is in a calcaneus position, so that the foot on the leg may be

TABLE II  
END RESULTS

	Feet Examined No.	End Results			
		Excellent No.	Good No.	Fair No.	Poor No.
Group I . . . . .	14	0	3	2	9
Group II . . . . .	21	7	6	7	1
Group III . . . . .	9	3	3	3	0
Total . . . . .	44	10* (22%)	12 (27%)	12 (27%)	10 (22%)

\* In 3 of these cases the heel cords were tight,—5 to 15 degrees.

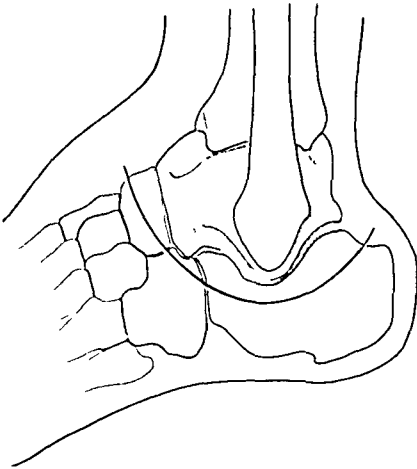


FIG. 1  
Showing incision.

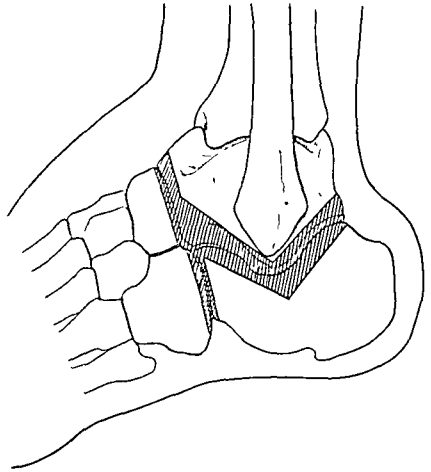


FIG. 2  
Showing amount of cartilage and bone removed from astragalus, cuboid, os calcis, and navicular to complete the V-shaped stabilization.

likened to an inverted Y, where the two short arms make a more acute angle than normally, and the posterior arm is relatively shorter than the anterior. This explains two important clinical findings,—lessened anteroposterior ankle motion and lessened leverage for both the tendo achillis and the tibialis anterior. This in turn accounts for the stiff foot and the heel-walking gait. Concomitantly, the long toe extensors become overactive in an attempt to elevate the dropped forefoot and to clear the floor with the toes in walking. When the extensors are overactive, the intrinsic muscles and the short flexors, in addition to being stretched, are used less and they, therefore, atrophy. With their loss, nothing prevents the toes from becoming cocked up. This is borne out clinically. Cocked-up toes go hand in hand with depressed metatarsal heads; with prominent metatarsal heads overlying calluses and painful bursae quickly develop.

The cavus deformities examined at follow-up were in association with poliomyelitis in twenty-four cases, spina bifida in three, idiopathies in three, Friedreich's ataxia in one, club-foot in one, and arachnodactylia in one. Of these cases, twenty were in females and thirteen were in males; twenty-two were unilateral and eleven were bilateral. The ages at the time of follow-up ranged from nine to twenty-seven years and averaged fifteen and nine-tenth years. The average age at the time of the first

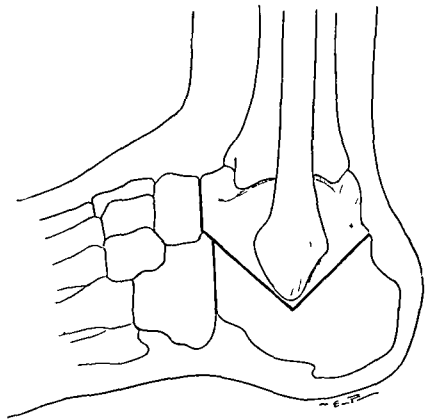


FIG. 3  
V-shaped stabilization completed.

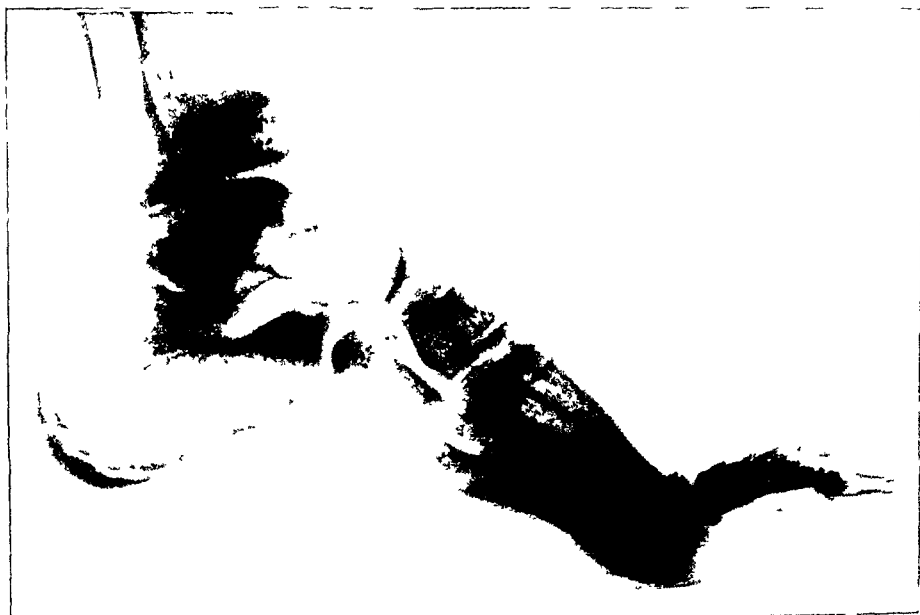


FIG. 4-A

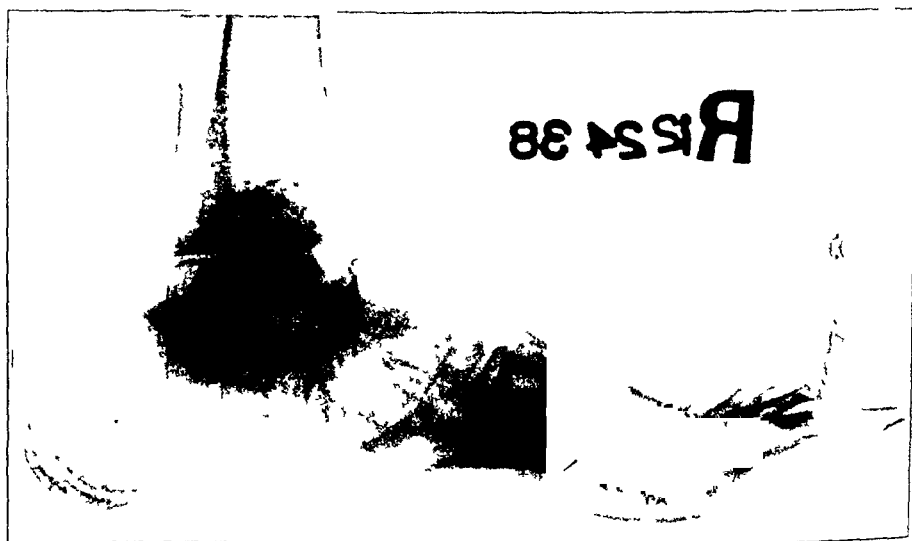


FIG. 4-B

Roentgenograms of right foot before and after operation, showing correction of deformity and solid bony union in subastragalar, astragalonavicular, and calcaneocuboid joints.

operation was eight years; at the last operation, nine and five-tenths years. During this operative period, in which the patients' ages ranged from three years to twenty-one years, ninety-two operations were performed on forty-four feet. These consisted of thirty triple arthrodeses (three of which were revised), twelve plantar fasciotomies, eleven transplantations of the long extensor tendons of the toes to the metatarsal necks, eleven Steindler stripping operations, six subastragalar arthrodeses, five astragalar os-



FIG. 4-C

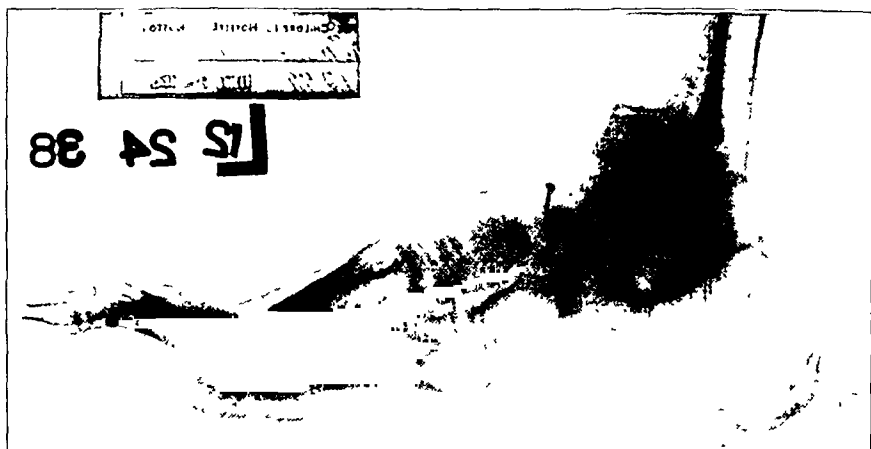


FIG. 4-D

Roentgenograms of left foot of same patient before and after operation, showing relief of cavus with enough shortening of foot to alleviate cocked-up deformity of toes.

teotomies, eight manipulations, two cuboid osteotomies, two lengthenings of the tendo achillis, one tenotomy of the flexor tendons of the toes, one excision of the proximal phalanges, one fascial sling to the mediotarsal joint, and two tractions.

It is obvious that many patients were subjected to more than one operative procedure, and each case would merit discussion, but, to avoid confusion, we have divided them into three groups convenient for comparison. Group I includes cases treated by such procedures as plantar



FIG. 4-E

Preoperative photographs at age of eleven years. Arachnodactyilia with marked bilateral claw-foot deformity.

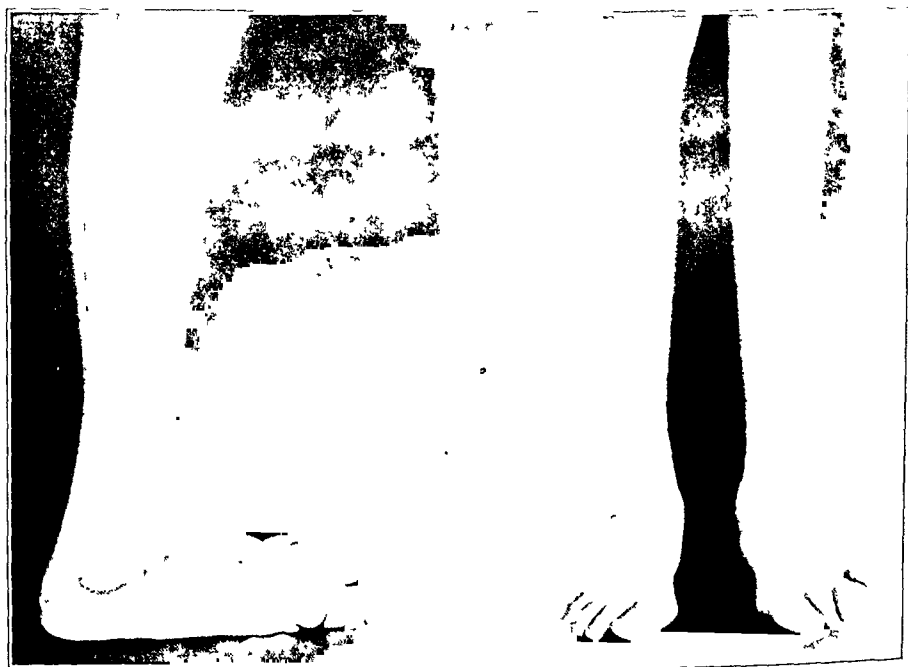


FIG. 4-F

Postoperative photographs at age of twelve years. Following a bilateral Hoke arthrodesis, there was excellent correction of the cavus deformity with good weight-bearing feet. The cocked-up position was relieved in all but two toes. There was no pain.

fasciotomy, Steindler stripping, osteotomy, and tenotomy, exclusive of those in which triple arthrodesis or transplantation of the long extensor tendons of the toes to the metatarsal necks was eventually done. Fourteen feet were so treated. Group II takes in those cases in which triple arthrodesis was done to relieve the cavus, and twenty-one such feet were examined. Group III presents nine feet which were treated by a combination of triple arthrodesis and transplantation of the long extensor tendons of the toes to the metatarsal neck in one or more toes.

We found it difficult to evaluate the end results, because of the extreme variation in etiology and treatment. However, we rated as "excellent" any foot which showed no residual cavus, no cocked-up toes, no calluses, and no pain. A foot presenting any one of these was rated as "good"; two, as "fair"; and three or more, as "poor". Tables I and II show the incidence of these residua and the end results, as distributed among the three groups.

An analysis of Tables I and II reveals that Group III has the lowest percentage of residual deformities, although Group II shows nearly the same percentage, except that cocked-up toes were strikingly more prevalent. The residual callus and pain present in Group III existed preoperatively in two cases, but in both were lessening in amount since operation. Group I shows very poor results, and in two of the three feet presenting no residual cavus the absence of this deformity was the result of traction treatment.

Of the ten cases (22 per cent.) which were rated excellent, seven were in Group II, while only three were in Group III. In other words, in both groups the result was excellent in one out of three cases. However, on further comparison it is noted that in two out of every three cases in Group III the results were good or better, while in only one and eight-tenths cases out of every three in Group II were the results good or better. This margin does not seem large, but the cases in Group III were the more difficult ones at the start.

Analysis of muscle charts showed that, with the exception of the intrinsics, each muscle group was good or better in more than 50 per cent. of the cases. The intrinsics were rated poor or worse in more than 50 per cent. of the cases. They were especially weak in feet with cocked-up toes.

The evidence here presented clearly points out that the best results can be expected in those cavus feet which are treated by a triple arthrodesis plus transplantation of the long extensor tendons of the toes to the metatarsal necks. This is especially true where cocked-up toes are a prominent feature. For relief of cavus, callus, and pain, and, to a certain extent, of the cocked-up toes, a triple arthrodesis alone is very efficient. The triple arthrodesis, when done to relieve the deformities of a claw foot, must accomplish several things:

1. The astragalus must be reshaped in order to elevate the forefoot, so as to flatten the long arch.

## IV. Exostoses:

- A. Sharp exostosis at the tendinous attachment of the greater tuberosity without other pathology, one case.
- B. Rounded exostosis on the greater tuberosity associated with tendon laceration, one case.

Although this classification is rather extensive for a small series of cases, it is necessary, since the type of repair differed for each group.

## I. PATHOLOGY NOT FOUND

Early in the series, a patient was encountered who complained of moderate continuous pain for one year, in spite of physiotherapy with diathermy, radiant heat, and massage. He gave an indefinite history of indirect injury caused by heavy lifting, and had a compensation background. Subsequent to operation, through other sources, it was found

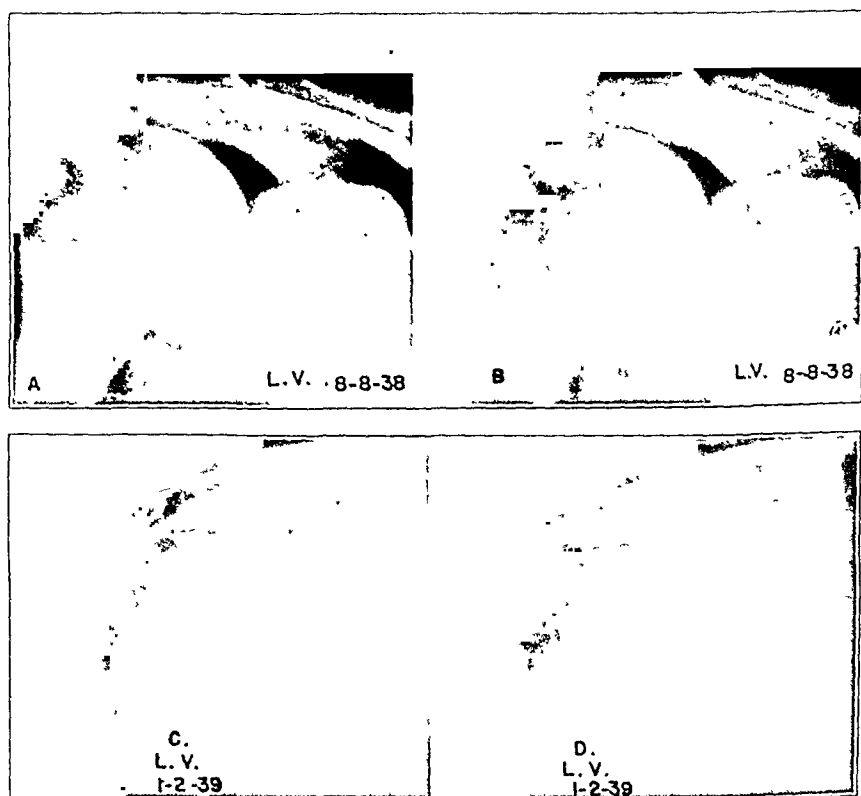


FIG. 21

L. V., female, forty-seven years old.

A (external rotation) and B (internal rotation) are preoperative roentgenograms showing avulsion of supraspinatus and infraspinatus tendons of eight days' duration. Sclerosis of upper border of tuberosity indicates that degenerative change must have preceded active rupture by some time.

C (external rotation) and D (internal rotation), taken five months after operation, show practically normal rotation. D shows smooth, healed margins of defect in greater tuberosity where tendons were transplanted. Sclerotic area in A and B was removed at time of transplantation. Note lack of rotation preoperatively and return of rotation postoperatively.



that the patient had attended other clinics and had complained of shoulder pain for at least three years. Clinical examination showed a loss of 30 per cent. active abduction with an inconstant complaint of a catch in the shoulder at about 15 degrees. Moderate tenderness over the attachment of the supraspinatus was present with some apparent protection on unguarded motion. Although roentgenograms were negative, a pre-operative diagnosis of possible avulsion of the deep portion of the attachment of the supraspinatus was made, and an exploration of this shoulder was decided upon. Long anterior dissection of the deltoid was done, and the whole shoulder, except for the teres minor tendon, was explored, including an incision along the anterior border of the supraspinatus tendon and inspection of its structure and deep-surface attachment. No pathology whatever was found. The patient returned to light work in three months and to full work in four months. When last seen, two years later, there were no complaints and no defect in motion or in strength. The rotator muscles showed no atrophy, and the previous catch at 15 degrees of abduction had disappeared. It is noteworthy that meanwhile the patient's compensation demands had been completely and permanently refused. Since this patient had had shoulder complaints before the question of litigation came up, we still do not know whether traumatic neurosis entered into the situation or whether some condition existed undiscovered.

## II. TENDON LESIONS

### A. *Complete Avulsion of the Short-Rotator Cuff*

The shoulders of four patients were explored, and each was found to have complete avulsion of the short-rotator cuff from its attachment, with displacement over the glenoid surface and a superimposed humeral head. All four cases were in workmen between the ages of twenty-nine and fifty-two years. Two of the patients showed definite evidence of laceration of the axillary nerve, one such laceration being complete. The history was of somewhat trivial injury. Two of the patients were merely pushing on a car, which moved from them suddenly, causing them to fall on their outstretched arms. Immediate dislocation of the shoulder occurred in each instance. Apparently in two of the cases complete avulsion of the cuff did not take place at the time of injury, but such avulsions occurred during reduction. Each of these patients stated that he was held down and, without anaesthesia, a doctor placed his foot in the axilla and, by extreme traction and manipulation, finally "reduced the shoulder". Both stated that they felt a tearing sensation and severe pain. Apparently the rotator cuff was torn off during manipulation in these two instances, and one of the patients suffered a complete laceration of the axillary nerve as well. Further evidence that primary avulsion of the cuff did not occur was found at operation. In both of these cases the margin of the greater tuberosity and the bone texture were normal, except for moderate atrophy consistent with the time interval since dislocation. In both instances

where primary avulsion of the cuff occurred with dislocation, the bone texture was chalky and fragmented easily. None of these patients had had injury or symptoms connected with their shoulders previously. All four presented the typical picture of inability to maintain reduction of the

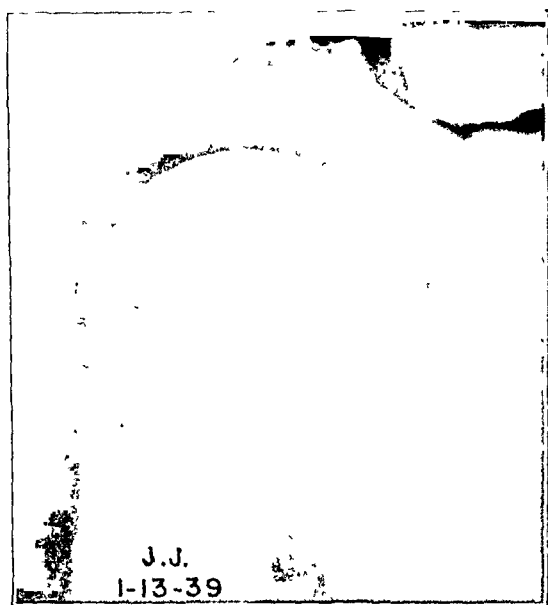


FIG. 22

J. J. Six-year result of old type of repair of avulsion of deep surface of attachment of supraspinatus and infraspinatus tendons. Ossification of tendon ends to border of tuberosity clearly shown. Ossified lesion entirely within tendinous area. Clinically, patient is completely normal and asymptomatic, and has been working steadily as a carpenter since nine months after operation.

dislocation, described previously by other writers. Although no question as to the diagnosis could possibly be raised by anyone having knowledge that such a lesion could exist, two of the patients had been treated with physiotherapy for three months and one for a month before the suspicion arose that anything more serious than the sequela of a dislocation was present. All had complete loss of active control. In the two cases existing for three months sufficient fibrous changes had developed to limit passive motion greatly, but the patients whose lesions had been present for one month and one week, respectively, showed complete range of passive motion with no discomfort.

Operative repair of this lesion has proved futile in all instances. In the first case avulsion recurred two weeks following repair, tearing off the chalky bone margin with the tendon, and the shoulder redislocated. (See Figures 9 and 23.) In one case repair was attempted one month after injury with complete exploration of the axillary nerve. The laceration of the nerve was found to have occurred among its smaller branches near the deltoid border or within its substance. The damage was irreparable. Reattachment of the cuff to bone contact was impossible; a total failure resulted, and shoulder fusion was advised but has been refused. The third case, of three months' duration, showed marked fibrosis of all structures beneath the deltoid. Without knowledge of the basic type of lesion present, it would have been impossible to determine the situation that existed or to dissect out the tendinous raphe from the scar tissue. Even knowing what to expect, it was a very difficult procedure. Finally satisfactory apposition of the scarred cuff to the margin of the greater tuberosity was secured. A fibrous ankylosis of the shoulder resulted, which was unsatisfactory for heavy use and allowed prac-

## SHOULDER LESIONS

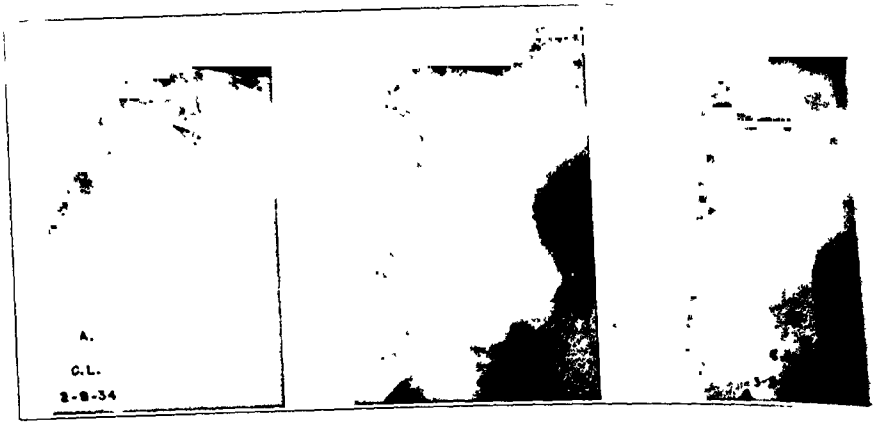


FIG. 23

A: C. L. Complete avulsion of short-rotator cuff with narrow space between acromion and humeral head. Cuff found turned over glenoid.

B: Redislocation two weeks after suture of cuff to tuberosity.

C: Reavulsed fragments of tuberosity, irregularity of margin of tuberosity, and hazy, chalky bone structure of upper humerus. Simple reduction present. The same chalky degeneration of the margin of the tuberosity was present in two cases of primary complete avulsion of cuff. (See text.)

tically no range of motion. Because of these failures, in the fourth case encountered, in which the lesion had likewise existed for three months, the patient was advised to have a primary shoulder fusion. He accepted this procedure and, four months following operation, returned to heavy work (calking twelve-inch water mains with lead) and has continued to do this work ever since. We cannot help feeling that in a patient over fifty years of age, when the tendinous attachment is weak enough to permit complete avulsion of the short-rotator cuff, attempts at reattachment are futile, and primary shoulder fusion is advisable. (See Figures 9, 10, and 23.) Attempts at repair are far more radical than shoulder fusion and much less satisfactory in outcome.

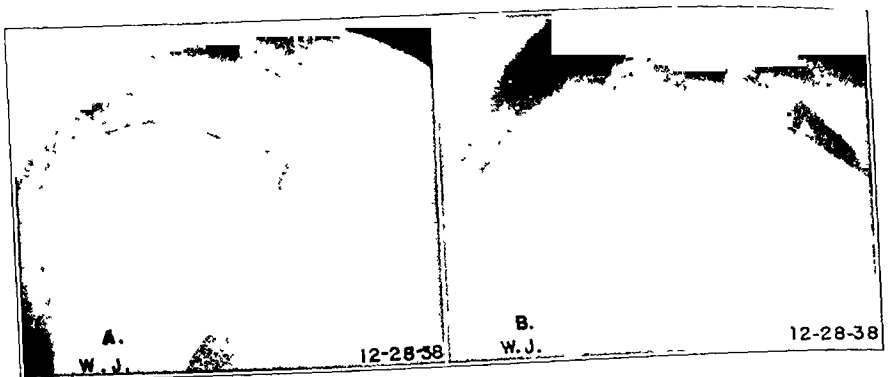


FIG. 24

A: W. J. Avulsion of cortical fragment of upper border of tuberosity by supraspinatus.

B: Immediate postoperative findings following drilling of fragment and suture with silk. Patient still in cast.

*B. Laceration or Avulsion of One or More Short-Rotator Tendons in Their Substance or at Their Attachments*

This group comprised seventeen cases. The types of laceration were quite distinctive, and, for this reason, they will be considered as follows:

1. Recent avulsion:
  - a. Of deep or superficial surface at insertion, four cases. (See Figures 7 and 20.)
  - b. Of entire thickness of tendon:
    - (1) Anterior portion of supraspinatus tendon, four cases.
    - (2) Complete tendon or tendons, four cases. (See Figure 2.)
  - c. With horizontal split, one case. (See Figure 4.)
  - d. With fibrillation or fimbriation, one case. (See Figure 5.)
  - e. Of cortical fragment at supraspinatus insertion, one case. (See Figure 12.)
2. Old avulsion (crescentic type), two cases. (See Figure 3.)

The general factors involved had no relation to the particular type of lesion. Twelve of the patients were men and five were women. The ages were between seventeen and fifty-three years. There were twelve lesions of the right shoulder and only five of the left. This is understandable in view of the fact that most of the injuries resulted from a fall or a twist with the arm outstretched. These patients have presented many other pathological conditions such as hernia, healed tuberculosis of the lung, etc., but in no instance was obvious arthritis, or arteriosclerosis, or any other generalized degenerative condition recorded. In each case injury alone was the etiological factor, and the variation in

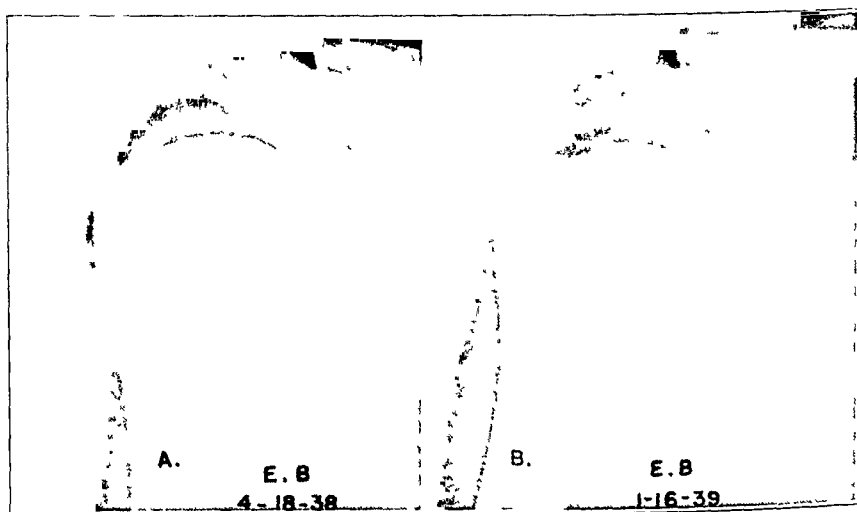


FIG. 25

*A:* E. B. Calcified area in supraspinatus tendon with extrusion of calcified material into bursa. Early ossification of tendon lesion caused failure of relief from attempted needling and washing.

*B:* Nine-month result of crescentic excision of ossified area with old type of suture of free supraspinatus margin to tuberosity. Clinically, patient is asymptomatic and has 100 per cent. motion and strength.

pathology found at operation merely represented the severity and type of injury plus changes due to the time interval. All of these patients had active occupations of laborious nature. Five were seeking compensation, and one was involved in a personal damage suit. It must be noted, however, that no trouble due to litigation was encountered among these six patients. Their progress and recovery were the same as those of the rest of the group.

In only one instance were both shoulders involved. This patient suffered hyperextension of both shoulders when under an anaesthetic for application of a plaster jacket for compression fracture of the spine. The sling on which he was supported, face down, gave way, leaving his entire weight resting on the arms. Mild symptoms in the right shoulder rapidly disappeared, but the left shoulder sustained a tendon laceration, which was repaired.

In two instances a previous dislocation of the same shoulder had been experienced: in one case the dislocation had taken place twelve years previously, and in the second case there had been four dislocations within the preceding three years.

The preoperative diagnosis was relatively correct in all but three instances. In two of these, recurrent dislocation without rotator-tendon injury was expected, but injury of one or more of the rotators was found. In the third case an exploration for rupture of the biceps tendon was done, but a laceration of the anterior half of the supraspinatus tendon was the true lesion. The words "relatively correct" do not refer to the mistakes in diagnosis, but to the fact that accurate knowledge of the exact subclass of laceration could not be preoperatively determined. One could safely expect to find a laceration, but could not determine its type or extent.

In only one case was direct injury to the shoulder a causative factor, and even in this instance we suspect that the patient fell on his outstretched arm, although he declared that he "fell on his shoulder". In four instances the patient was rendered un-

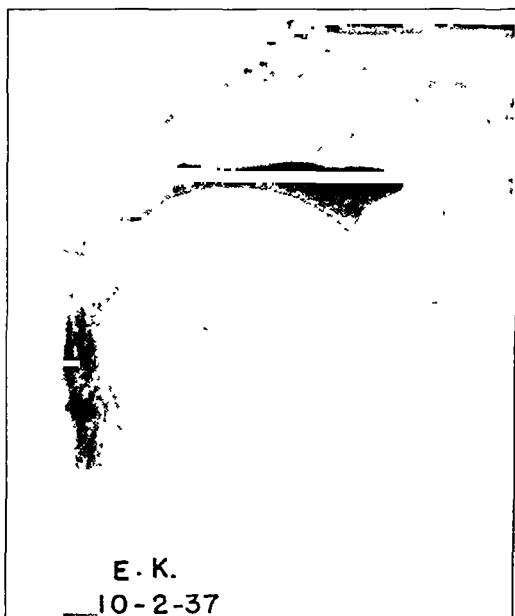


FIG. 26

E. K. Preoperative findings in case in which rounded, polished, localized, sclerotic exostosis was present on greater tuberosity, associated with fibrillated, degenerative lesion in supraspinatus tendon of eighteen months' duration. Clinical recovery 85 per cent. Painless motion followed exostosectomy and cross suture of defect.

conscious at the time of injury and did not know how the shoulder was hurt. In each of the other cases the patient definitely stated that the arm was outstretched at the time of injury.

The duration of symptoms varied greatly, depending directly on how soon after injury the patient was seen by a physician who knew that this lesion occurs and who was examining the patient with this pathology definitely in mind. One patient was operated upon six days after injury, two received operative treatment eight days after injury, and, in the rest of the cases, the interval between trauma and surgical intervention was weeks or months (in one instance, three years). Too much blame should not be placed upon the examining physician, since other more dramatic injuries may overshadow the shoulder lesion. We, ourselves, missed a complete rupture of the supraspinatus and the infraspinatus tendons for six weeks because the patient was critically ill with a fracture-dislocation of the hip and pneumonia. Fortunately delay even of several weeks' duration does not seem to prejudice the outcome of repair. Every patient whose lesion was not immediately recognized had had physiotherapy preoperatively, and several had been under constant intensive treatment for several months.

Recent avulsions of the deep surfaces of the tendons at their insertion occurred in three cases. The upper-surface attachment was similarly found broken on one occasion. In each case the patient complained of mild pain and tenderness localized to the point of laceration, with a variable amount of catch as the tuberosity passed under the acromion in abduction. Active motion was unlimited in three patients, but markedly limited in the fourth, who, at the time of exploration, was found to have advanced adhesions within the bursa and about the subscapularis tendon. This latter patient had marked atrophy of all the muscles of the shoulder girdle, whereas the others had none. Slight spasm and protection were present in the three without associated bursal adhesions, but there was no sulcus, eminence, or arm-drop sign. The patient with adhesions resembled from every standpoint the cases of "frozen shoulder". Marked localization of the tenderness over the attachment of the supraspinatus led us to the correct preoperative diagnosis of laceration. In each of the three cases without bursal adhesions the symptoms were disabling for actual heavy work, but did not completely rob the patient of the use of his shoulder. (See Figures 7, 20, and 22.)

The chief importance of the deep-surface lesion lies in the fact that it is so well hidden. When the bursa is opened, the top surface of the tendon, which is still intact, may appear slightly yellowish or unchanged. Unless one dissects under the anterior edge of the supraspinatus tendon, the basic pathology will be missed and the patient will not be benefited by operation. By passing a curved instrument through a small slit at the anterior edge of the supraspinatus, and by palpation of a finger above the point of the curved instrument as it passes along the tendon, one can examine the tendon structure and attachment. Any irregularity or thinning

of the tendon is then easily and definitely demonstrable. In these cases completion of the tear by division of the insertion and suitable reattachment have been satisfactory in relieving complaints and restoring usefulness of the joint. Degeneration within the tendon substance was grossly apparent for a variable distance from the site of laceration in the older cases. Changes in the bursa and in the articular cartilage of the humeral head were not grossly noted in these cases except in the one with associated adhesions already mentioned. The bone texture of the tuberosity itself was normal. The avulsion-defect surface on the bony portion of the cleft appeared to be covered with granulations and tendon remnants. The underlying cortex was sclerosed. (See Figure 21, A.) The tendinous portion of the cleft appeared to have degenerated, and the width of the avulsed area was greater than that of the bone surface to which it had originally been attached, due to retraction of the broken surface of the tendon.

Recent avulsion through the entire thickness of the anterior portion of the supraspinatus tendon alone was encountered four times. The symptoms did not vary from those described for recent avulsion of the deep surface at the insertion except in the severity of the complaints. The patients had exquisite localized spot tenderness with a greater amount of pain. There was a complete range of active motion, but extreme pain was experienced as the lacerated area passed under the acromion. Spasm and protection were greatly increased, and, because of this, there was marked loss of strength. The arm-drop sign was suggestive, but not completely positive in any instance. In each case a fairly gross crepitus could be felt as the lesion passed under the acromion. No sulcus or eminence could be palpated. The shoulder was badly disabled, but without the clear-cut and classic signs of rupture of the entire width of the tendon. Because of the severity of symptoms, the patients readily submitted to operation. Opening of the bursa in each case revealed definite small lacerations of the floor of the bursa over the tendon lesion without adhesions or evidence of hemorrhage, although in one instance the lesion was of only eight days' duration. A twist was associated with injury while the arm was outstretched. The tendon laceration grossly was fibrillated and seemed to pout out through the associated rent in the bursal floor. Fraying extended proximally into the tendon substance for from one-fourth to three-eighths of an inch, and retraction made the injured area appear circular. The underlying articular cartilage appeared normal, and the distal ruptured fibers attached to the bone showed no evidence of fibrosis or of granulation tissue. There was no apparent tendency to healing, although one of the lesions had existed for six months. All lesions appeared the same grossly regardless of time intervals, which were eight days, six weeks, two months, and six months. Repair resulted uniformly in an asymptomatic shoulder with practically complete return of motion.

Recent avulsion of a complete tendon or tendons was found in four



Fig. 27

O. B. Tendinous insertion into the greater tuberosity of the humerus shows longitudinal, horizontal split with slight hemorrhage into the lacerated area. There is no inflammatory reaction or organization. The insert shows the area from which the section was removed. Duration of lesion, one week. (Low magnification.)

cases. The cases in this classification showed most if not all of the clinical requirements demanded by Codman for rupture of the supraspinatus tendon. The symptoms and complaints are really an exaggeration of those of the previous two groups,—namely, those with avulsion of the deep surface and those with full-thickness rupture of the anterior portion of the supraspinatus tendon alone. These are the typical cases. It is noteworthy that they constitute less than one-third of all lacerations of the tendons of the short rotators, although the other lesions may be equally disabling so far as active laborious occupation is concerned. In three of these cases the lacerations of the supraspinatus and the infraspinatus tendons were complete, and in one, in which there was a recurrent dislocation, the subscapularis tendon alone was involved.

In this latter case the patient gave a history of four redislocations of the shoulder within three years, the most recent one having occurred two months previous to operation. The joint was explored for the purpose of transplantation of the biceps tendon, without preoperative expectation of a ruptured rotator tendon. The rotators were explored as a routine measure, and we were amazed to find complete rupture of the subscapularis tendon with thin, long, ineffectual, fibrous repair. This was the only case in the series in which repair was noted, and it is of outstanding interest that such fibrosis occurred only in the presence of sur-



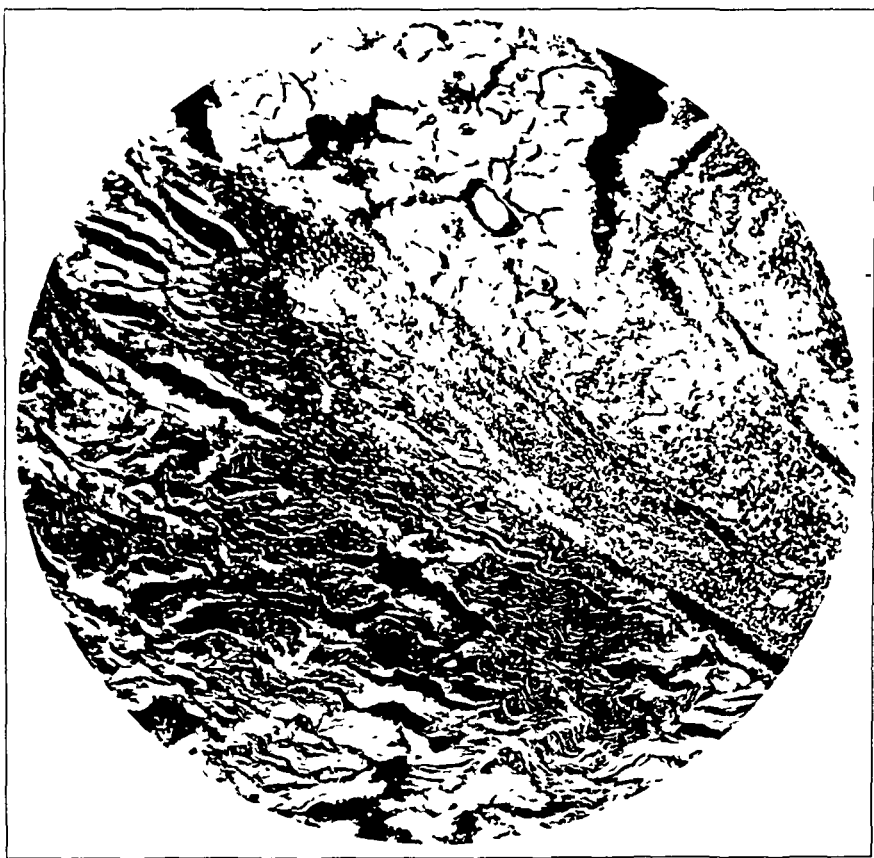


FIG. 28

E. B. Fragmentation of tendon appears below. Hemorrhage present through the central area. Degeneration, calcification, and early slight ossification are seen above. Duration of symptoms, two weeks only. Old degenerative process must have existed much longer than actual acute rupture. No tendency toward repair present.

rounding soft tissue when the torn tendon did not lie between bony structures. The preoperative symptoms and complaints were those of recurrent dislocation without any of the findings of laceration of the short-rotator tendons, and repair was readily secured by the old method of suture of the denuded tendon end to the denuded lesser tuberosity. Transplantation of the biceps tendon was also done, although we feel that it would have been unnecessary in this case in preventing redislocation. This case has raised in our minds the question as to whether other recurrent dislocations in the past have not been due to avulsion and stretched fibrous repair of the subscapularis tendon, which have gone unnoticed.

Having removed this case from discussion in the present group by this explanation, we will consider the remaining three in which there was complete laceration of the supraspinatus and the infraspinatus tendons, plus avulsion of the cortical attachment of the teres minor in



FIG. 27

O. B. Tendinous insertion into the greater tuberosity of the humerus shows longitudinal, horizontal split with slight hemorrhage into the lacerated area. There is no inflammatory reaction or organization. The insert shows the area from which the section was removed. Duration of lesion, one week. (Low magnification.)

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thickness of only the anterior half of the supraspinatus tendon or the deep surface of the insertion of the supraspinatus and the infraspinatus tendons. The old type of repair by direct suture of the tendon end to the tuberosity secured a good but much slower and less complete result than the new type of repair. This may be due to several reasons, such as removal of degenerated tendon from the actual joint by overlapping, reestablishment of more normal tone by imbrication, or less damage to the remaining articular-cartilage margin by necessary curettage of the surface of the tuberosity in the old type of repair. (See Figures 2 and 21.)

Recent laceration with a horizontal split in the supraspinatus and the infraspinatus attachment with normal superficial and deep surfaces of the tendon was encountered in one case. This patient was seen within twenty-four hours and exhibited all the cardinal signs of complete avulsion of the supraspinatus and the infraspinatus tendons. Repair was delayed for six days for observation, since, as has been shown, moderate delay does not seem to impair the results of operative repair. At the end of six days pain had markedly decreased, but the other signs such as arm drop, initiation of abduction, etc., were still present, although no sulcus or eminence was demonstrable. Satisfactory examination for these latter two findings was impossible because of tenderness. Exploration revealed a normal bursal roof and floor. We were so positive of supraspinatus-tendon damage, however, that a small incision was made along the anterior margin of the supraspinatus tendon, and the cleft within the tendon substance, extending proximally for five-eighths of an inch, was immediately apparent. Having in mind recent photomicrographs which showed no tendency to repair in lesions of the supraspinatus and the infraspinatus, it was decided to complete the new type of repair. This satisfactorily transplanted the damaged area of tendon outside the actual mobile portion of the joint. This patient has been too recently operated upon to permit an estimate of the final result, since the shoulder has been out of plaster abduction less than one month. (See Figures 4, 6, and 27.)

Recent fibrillated laceration without avulsion, in which the supraspinatus tendon appeared to be crushed into several bundles of fibers, but was not lacerated transversely, was encountered once as the only lesion and a second time associated with complete transverse laceration of the deep half of the tendons. In both instances the supraspinatus and the infraspinatus tendons were involved for three-fourths of an inch at their insertion. The case in which there was an associated transverse laceration of the deep surface has already been described as one of the group of cases of recent avulsion of the deep surface and as the case in which there were associated bursal and subscapularis adhesions, so that it resembled a "frozen shoulder". In the other case the patient had slight pain with moderate localized tenderness, complete loss of internal active rotation, gross crepitus on motion, and slight spasm and protection, but marked loss of power. The situation had existed for eighteen months, following a direct fall on the unprotected shoulder. When the bursa was

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FIG. 29

A. M. Ossification of supraspinatus tendon with degenerated, calcified, tendinous tissue surrounding lesion. Ossified area too large to be wholly included, but complete periphery showed similar picture. Duration of symptoms, five months. Lesion had undoubtedly been present unnoticed much longer.

opened, it was found markedly thickened and scarred. A circular defect was seen in the floor with a large, round, smooth, eburnated exostosis, about one centimeter in diameter, presenting from the lateral surface of the central portion of the greater tuberosity. (See Classifications II, B and IV, B.) Over a fibrillated area of tendon the bursal floor was retracted and thickened. The fibrillation could be easily palpated through the bursal floor and was exposed when the latter was incised. An attempt at lateral suture of the fibrillated area was unsatisfactory, and, since at the time this patient was treated the new type of procedure for transplantation of the tendon and removal of the damaged area from the joint had not been devised, it was considered impossible to remove the fragmented area of tendon and to secure reapposition of good tendon to the tuberosity. The exostosis was, therefore, removed, and the joint was closed with the unsatisfactory repair described. Good functional recovery slowly ensued, but considerable loss of strength has persisted. (See Figures 5, 6, 18, and 26.)

Recent avulsion of cortical fragment by the supraspinatus was en-

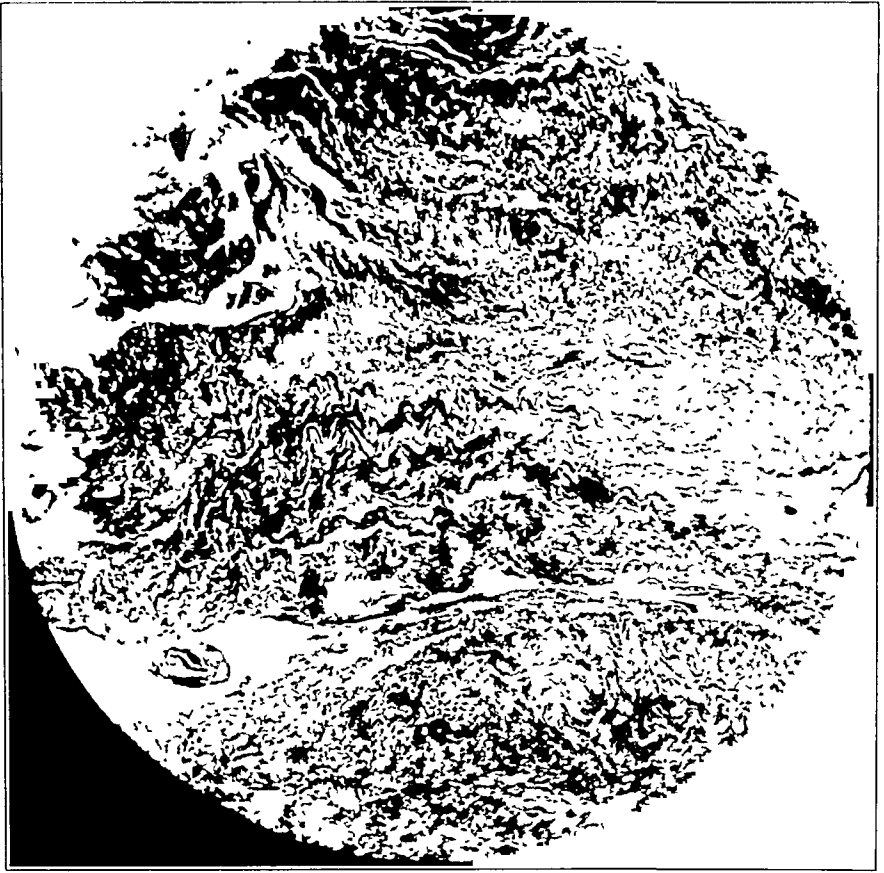


FIG. 30

A G Massive degeneration and fragmentation shown. No evidence whatever of repair. (High-power magnification.)

countered once. Complete loss of motion with pain, spasm, and protection, plus roentgenographic demonstration of an avulsion fracture, were diagnostic. When the bursal roof was opened, moderate hemorrhage was encountered, with laceration of the floor over the fracture site. The fragment could not be replaced by manipulation of the arm, but was easily replaced with instruments and maintained in position by silk sutures placed through drill holes. The patient is still in plaster at the present time. (See Figures 12 and 24.)

Old crescentic laceration of the supraspinatus and the infraspinatus tendons was encountered twice. In one case, of six months' duration, the lesion was immediately recognized, but treatment was impossible until later because of associated severe spine fracture. In the other instance, of four months' duration, intensive physiotherapy had been given without proper diagnosis. In each case the preoperative examination showed a shoulder with moderate continuous pain and localized tenderness, marked limitation of both active and passive abduction when the greater tuberosity contacted the border of the acromion, and moderate limitation of

rotation, flexion, and extension. Marked atrophy of the shoulder girdle with spasm and protection on extremes of motion was present. An eminence was palpable, but no clear-cut sulcus could be felt. When the bursa was opened, it was not thickened. Adhesions were found, which partially obliterated it, and the humeral head was plainly visible in a typical crescentic defect with a thin edge, a degenerated margin, and no evidence of repair. The superficial surface of the avulsed tendon was smooth and covered with bursal floor. The under surface was still somewhat rough and fibrillated; the lacerated appearance extended over a wider area than the original point of tendinous insertion would have occupied. The articular cartilage of the humeral head appeared relatively normal, but the greater tuberosity was eburnated, and tendon remnants had almost completely disappeared. In one case a line of apparent granulation tissue occupied a small area between the articular-cartilage surface of the humeral head and the base of the greater tuberosity. Good but incomplete return of function and power slowly occurred in the earlier case in which the old type of operation was used, and similar slow return of function is taking place in the second case in which the new method was employed. Apparently in shoulders with damage of this nature and with subsequent degeneration and adhesions recovery is slower and less complete. (See Figures 3 and 30.)

#### *C. Musculotendinous Separation of the Supraspinatus and the Infraspinatus*

Separation at the musculotendinous junction of the supraspinatus was encountered in one case. It had existed for nine months and resulted from a fall in which the patient had been caught hanging by one hand on a rope. The main complaints were of loss of power and of loss of 50 per cent. of motion in abduction of the shoulder. There was subacromial tenderness, but it was not well localized. Moderate atrophy of the supraspinatus and the infraspinatus muscles was present. At operation, a normal bursal roof and floor were present. The tuberosity and the exposed tendon were intact. Incision anterior to the supraspinatus and palpation of the tendon against an inserted curved instrument revealed a massive thinning of the tendon high under the acromion with fibrillation of the under surface in the vicinity of the musculotendinous junction. The new type of repair was attempted for the first time in this case, but was not successful, due to the impossibility of removing the lesion as described from the actual mobile portion of the joint. We feel sure that shoulder fusion will finally be necessary to give relief in this instance. (See Figure 8.)

#### *D. Calcification or Ossification of the Supraspinatus Tendon*

Ossified and calcified lesions of the supraspinatus tendon have been encountered in two patients. Symptoms had existed for two weeks in each case; the onset had been gradual, but in one case had been associated with a slight strain from sudden elevation of the arm. The patients

complained of severe pain on any attempt at abduction, although rotation, flexion, and extension were fairly free and only slightly painful. There was localized exquisite tenderness. All signs elicited by abduction were hidden by acute spasm and protection. Roentgenographic examination in each case showed a calcified shadow within the supraspinatus tendon and in one instance a slight spread of the calcium into the subacromial bursa. Preoperative needling in the second case, with attempted aspiration and lavage, failed to give relief. Opening of the roof of the bursa revealed that the floor was red, oedematous, and slightly raised over a small area of the anterior portion of the supraspinatus tendon near its insertion. At the center of this area was a yellowish-appearing lesion. The whole appearance was that of an inflamed skin infection or boil. Incision of the central portion failed to evacuate any material. In both instances the lesion was excised for section. In the first case an old type of repair was done with direct suture of the tendon to the tuberosity. The abduction brace was removed by the patient at the end of three weeks, and he returned to full work as a clerk at the end of six weeks. Complete recovery with a full range of motion rapidly ensued, and there has been no recurrence during two and one-half years of observation. In the second case repair was obtained by making the incision in a crescentic form and suturing the tendon to tendon. Recovery was practically complete in five months, and there has been no recurrence during a year of observation. (See Figures 14, 15, 25, 28, and 29.)

### III. BURSAL LESIONS

#### A. *Obliterative Subacromial Bursitis (Frozen Shoulder)*

Two patients with this lesion were operated upon: in one case the lesion had existed for one year, and in the other it had been present for nine months. Preceding operation, both patients had received intensive physiotherapy elsewhere. The clinical findings were typical. There was complete loss of scapulohumeral motion with extreme pain, spasm, protection, and massive atrophy of the rotators and deltoid with marked generalized subacromial tenderness. One case followed an attack of "*la grippe*"; the other, a moderate wrenching strain on the outstretched arm. Both patients were women over fifty years of age in excellent general health and without other referable pathology. The first patient presented marked atrophy of the scapula and humerus, so that the roentgenographic appearance of the coronoid process as seen end on was massively cystic. This was one of our early cases and the shoulder was opened for biopsy of the coronoid process, which was found to be normal. The subacromial bursa was totally destroyed, so that sharp dissection with a knife through fibrous tissue was required to restore the cleft which the bursa had originally occupied. Following plaster abduction of the arm for six weeks, the patient rapidly regained motion, and returned to full work two months after removal of the plaster. Complete motion was present about six months after operation. The patient has been followed



for three years without any sign of recurrence. The second resembled the first as to pathology and length of disability. The first has had no recurrence during the past year and a half. (See Figure 16.)

### *B. Laceration of the Bursal Floor*

This condition was encountered in all cases of complete rupture of tendon substance. In one instance, however, the laceration appeared discrete and unusual. In this case the bursal floor had been torn in a triangle with the anterior leg along the anterior border of the supraspinatus and the posterior leg along the top of the greater tuberosity. The three-cornered defect had been scuffed backward and upward and had been attached in a riffled line like a freshly cut Thiersch skin graft lying on a razor. It was easily dissected free, replaced, and held with one suture at its apex. Complete and rapid recovery of function ensued, and no recurrence of symptoms has taken place within the last year. (See Figure 17.)

## IV. EXOSTOSES

### *A. Sharp Exostosis at the Tendinous Attachment of the Greater Tuberosity*

Sharp exostosis at the tendinous attachment of the greater tuberosity, limiting motion by impingement against the acromion, has been repaired in one case. The lesion occurred following severe sudden hyperextension of the arm, and was associated with preceding symptoms of mild bursitis. Pain, with limitation of abduction, plus roentgenographic demonstration of the lesion were diagnostic. When the bursa was opened, the floor was found to be intact over the exostosis. The periosteum was divided one inch below the lesion and carefully dissected upward with the bursal floor intact well onto the tendon. The exostosis was smoothly removed, and the periosteum and the bursal floor were replaced. Abduction was maintained for six weeks in a cast and was gradually decreased for two weeks in a brace. The patient returned to work at a desk occupation one week later and rapidly regained 75 per cent. of motion in the shoulder, which is in excess of the motion present in the opposite arthritic, uninjured joint. (See Figure 19.)

### *B. Rounded Exostosis on the Greater Tuberosity Associated with Tendon Laceration*

The case with the rounded exostosis has already been reported as one of the cases of recent fibrillated laceration. (See Figures 18 and 26.)

## NEW TYPE OF OPERATION

Because of the gross appearance of degeneration of lacerated tendon extremities, the extensiveness of tendon-insertion injuries, and the necessity of repairing split-tendon defects of the short rotators of the shoulder joint, it was found necessary to develop some method of mobilizing the attachment of the supraspinatus and the infraspinatus tendons sufficiently

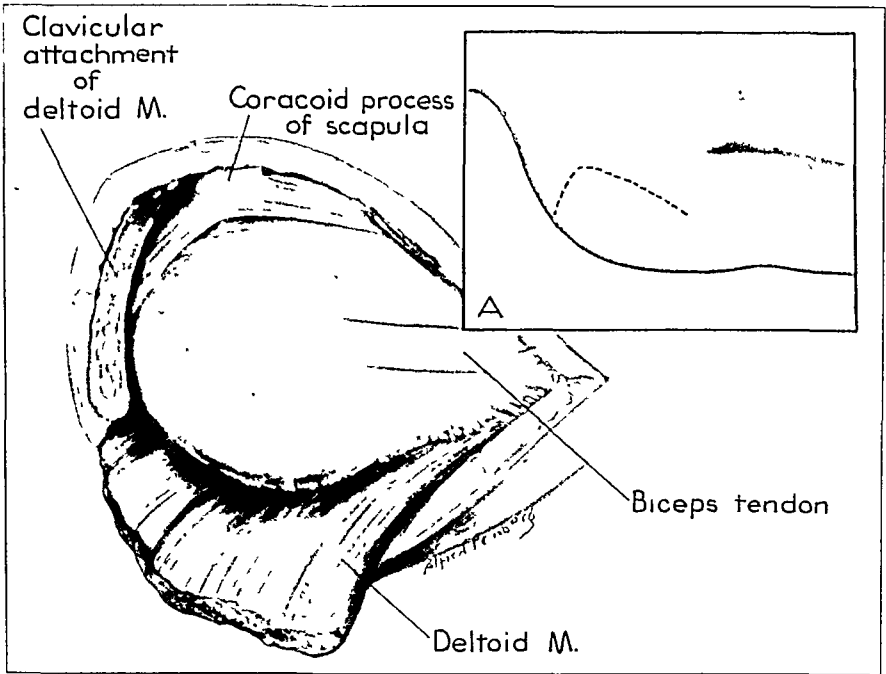


FIG. 31

The deltoid, freed from the pectoralis major and its acromioclavicular attachment, is turned back and downward. The bursal roof is exposed.

A: Skin incision.

to allow their transplantation downward on the humerus. It was found that, following division of the anterior border of the supraspinatus tendon and the posterior border of the infraspinatus tendon from the rest of the short-rotator cuff, these two tendons could be easily retracted from one to one and one-half inches downward beyond their usual position. Since these incisions left a wedge-shaped tendon, it was noted that on downward re-

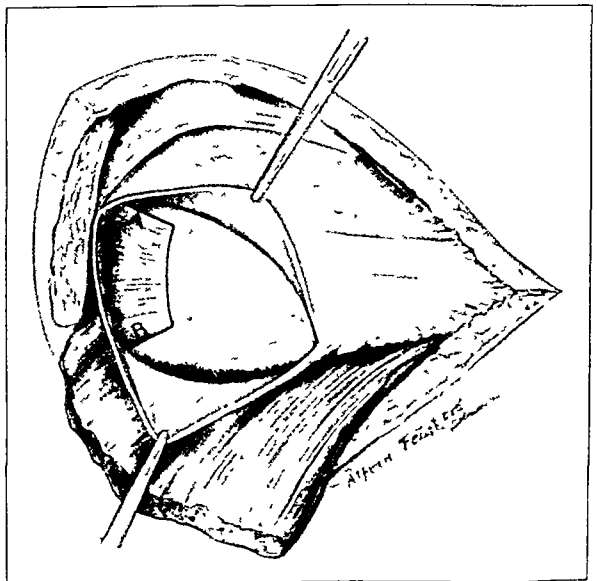


FIG. 32

The bursal roof has been opened vertically, and the line of incision of the attachment of the supraspinatus and the infraspinatus tendons is indicated. The incisions at A and B extend upward along the anterior and posterior borders of these tendons, freeing them from the rest of the tendinous cuff and allowing their mobilization.

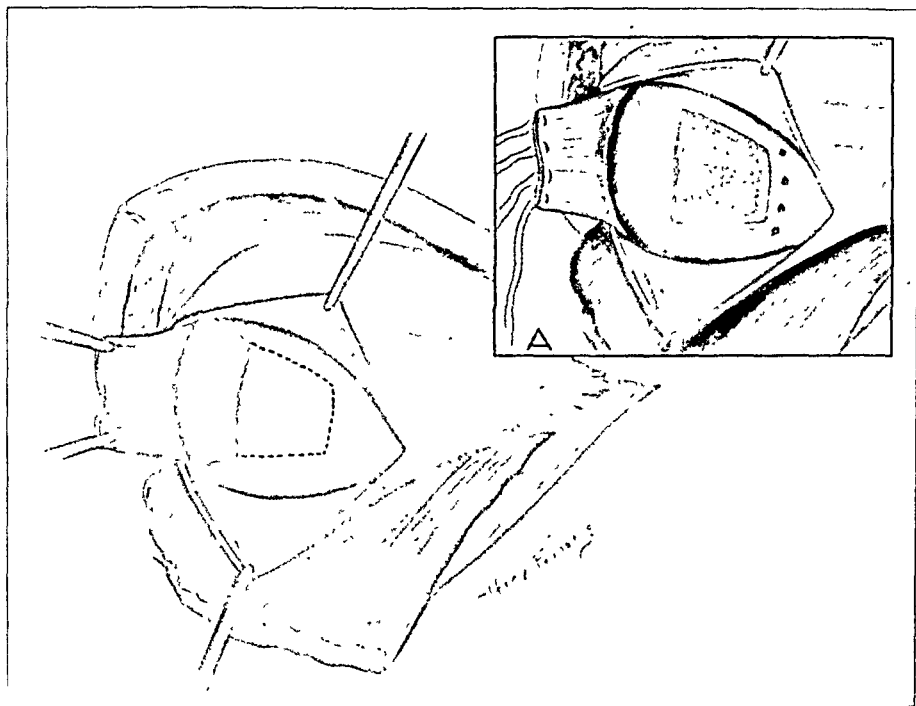


FIG. 33

The tendons of the supraspinatus and the infraspinatus are freed from their insertion and the rest of the cuff, and are turned upward over the acromion. The line of tuberosity osteotomy is indicated. Note that the triangular shape of the tendons drawn into a narrowing defect maintains apposition of their margins with the bone defect and the previously divided borders of the cuff.

A: Four mattress sutures through the free tendon end are placed from the under surface. The bone mass has been removed, creating a defect for transplantation of the tendons. Four holes have been drilled through the lower cortical margin. Note that the end holes are placed beyond the width of the defect, so that the pull on the tendon when fastened in place will flatten it out and cause a tight lateral coaptation of its margins with the sides of the osseous defect.

traction the gap formed in the short-rotator cuff by the release afforded by the incisions was again filled by the wedge-shaped supraspinatus and infraspinatus tendons as they were retracted downward. It was also noted that downward retraction of these tendons for approximately one inch did not increase their tension on the muscles beyond that expected from normal muscle tone. Hence it only remained to cut a wedge-shaped area from the greater tuberosity of the same depth as the tendon substance and to fasten the tendons in place. This repair removes the distal portion of the tendons from the active mobile portion of the joint, together with any degenerative or other lesion localized in the distal inch of the tendon substance. The bursal floor, if previously lacerated, will have been replaced with that attached to the upper surface of the retracted tendons. (See Figures 31, 32, 33, and 34.) This procedure has been carried out in eight cases since June 1938. The speed of recovery has been much greater than in the previous simple suture of the tendon end to the tuberosity. It is, of course, too recent a procedure to permit the report of true end results.

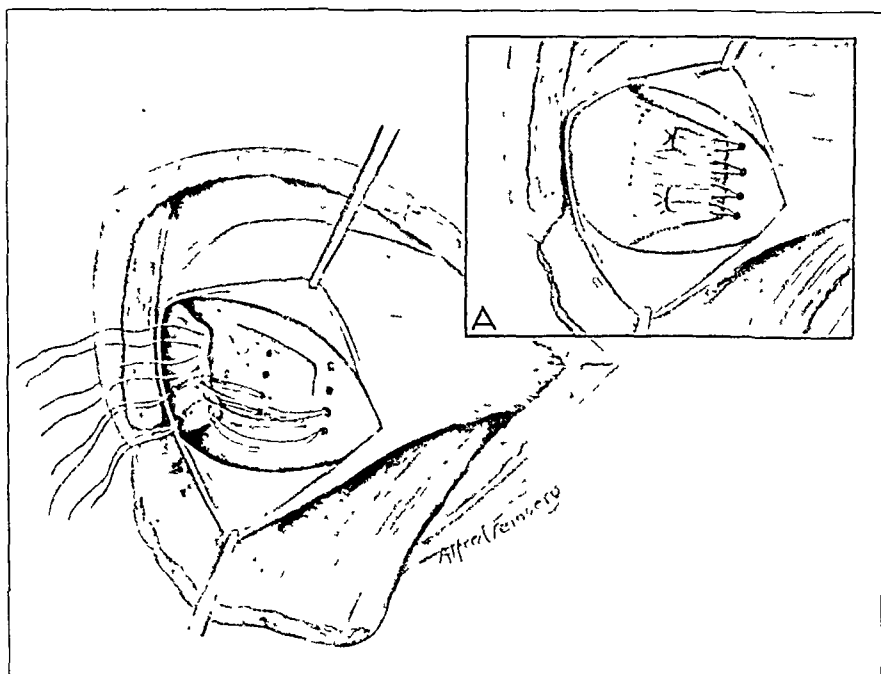


FIG. 34

The two posterior mattress sutures have been led through the cortical drill holes from without inward, upward through the cancellous bone in the floor of the defect, and thence upward through the tendon, emerging on its superficial surface about three-fourths of an inch proximal to its free cut margin.

A: All four sutures have been passed as described and are tied across the tendon in pairs. The tendon is drawn tightly into the defect longitudinally and is bound down by the method of suture in close apposition with the floor of the defect. Note that the bursal floor on the superficial surface of the tendon has filled the defect caused by removal of the tuberosity area and that the distal inch or more of tendon has been removed from the actual mobile portion of the joint. The bursal roof remains intact ready for suture.

#### CONCLUSIONS

1. Thorough inspection of the shoulder joint and complete and satisfactory repair of any gross lesion demand wide exposure. The division of the deltoid fibers described leaves no permanent clinical defect.

2. Lacerations of the supraspinatus and the infraspinatus tendons show no gross or microscopic evidence of repair or of fibrosis, but they do show progressive degenerative changes with associated fibrotic lesions in the subacromial bursa and about the subscapularis tendon. Old crescentic lesions are the result of "tear and wear" and not of "wear and tear".

3. Laceration of these tendons may be expected to cause progressive degeneration and increasing symptoms.

4. A new subacromial-bursa formation may occur after complete obliteration following sharp dissection, replacement of the mobile elements at their highest functional point, and gradual lowering after healing. There is apparently a drawing-out of new bursal lining from the portion of the bursa remaining under the acromion process.

5. Calcified shadows in the short-rotator tendons may actually be osseous in formation and, therefore, impossible of removal by conservative means.

6. Repair of complete avulsion of the short-rotator cuff is unsatisfactory, and primary shoulder fusion is indicated, especially when complete axillary-nerve lesion is present.

7. Moderate delay of operative interference in suspected acute ruptures does not prejudice the final outcome, and is justifiable.

8. Diagnosis of suspected short-rotator-tendon laceration has been exceptionally accurate, but the lesion itself may be hidden and its demonstration may require more complete exploration than simple bursal incision.

# THE CENTRAL BONE GRAFT IN JOINT ARTHRODESIS \*

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*From the Shriners' Hospital, Springfield*

The desirability of some form of internal fixation when major joints are fused or arthrodesed has been expressed through the use of bone pegs, nails, mortising, etc. The method to be described was first used by the author in knee-joint fusion about eleven years ago, and we have continued to employ it for the following reasons: It affords immediate positive fixation in the position of election, it expedites fusion, and the technicalities add but a few minutes to the average operating time for other types of arthrodeses. In over half of the cases there was clinically firm fusion at the end of two months and, with a few exceptions, clinically and roentgenographically solid fusion in all cases at the end of four months; while six to twelve months were required to obtain solid fusion by the other methods.

The author makes no claim to originality in the use of a bone graft, but the technique to be described has not been recorded in the literature at his disposal. Key has presented a somewhat similar procedure in respect to the knee joint, and it is not at all improbable that many surgeons have conceived of the author's method or a better one.

## OPERATIVE TECHNIQUE AS APPLIED TO THE KNEE JOINT

The joint is opened by a linear incision (Fig. 1, A) from above the

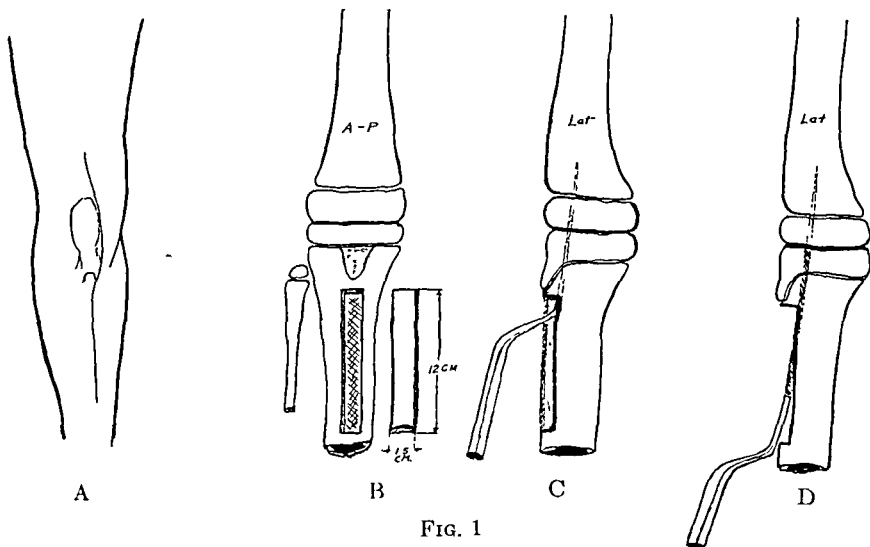


FIG. 1

- A: Incision.
- B: Articular surfaces excised; graft removed.
- C: Bayonet osteotome forms tunnel for graft, transfixing fragments.
- D: Graft driven through tunnel with bone set.

\* Read at the Annual Meeting of the American Academy of Orthopaedic Surgeons, Memphis, Tennessee, on January 18, 1939.

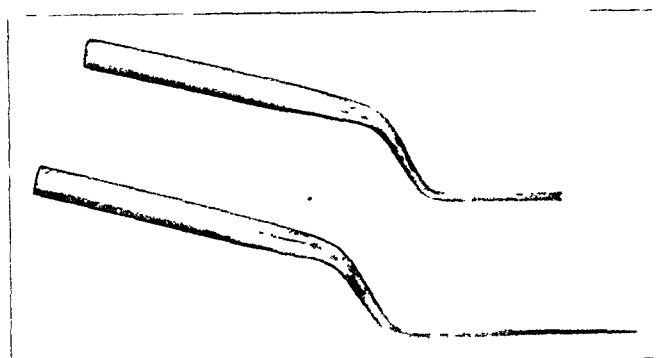


FIG. 2

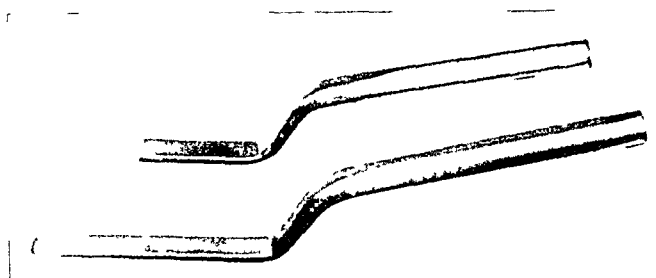


FIG. 3

Bayonet osteotome used for making tunnel and bone set or driver used in placing graft

five-tenths by twelve centimeters, is removed with a motor saw or an osteotome (Fig. 1, *B*). The tunneling osteotome is driven upward from the graft bed across the joint line well into the femur (Fig. 1, *C*). The alignment is checked, and necessary adjustments in position are made at this time. The instrument is then retracted, leaving a tunnel through

patella to the junction of the upper and middle thirds of the tibia (Fisher incision elongated downward). The patella is dissected from the quadriceps femoris above to prevent upward displacement, which often occurs when the muscle attachment remains. The articular surfaces of the joint are removed with a saw or an osteotome and are properly fitted. The upper third of the tibial crest is exposed; a transverse cut is made just below the level of the tubercle; and a graft, one and



FIG. 4-A

S. B., aged nine years. Tuberculosis of the left knee. Before operation, July 8, 1931.

which the graft is driven (Fig. 1, *D*). Two instruments—one for making the tunnel and the other for driving the graft—are more or less indispensable (Figs. 2 and 3). A little care is necessary in handling the graft, especially if it is thin from atrophy; we have had one case in which the



FIG. 4-B

S. B. After operation, January 8, 1932.



FIG. 4-C

S. B. Two months after operation, March 4, 1932.



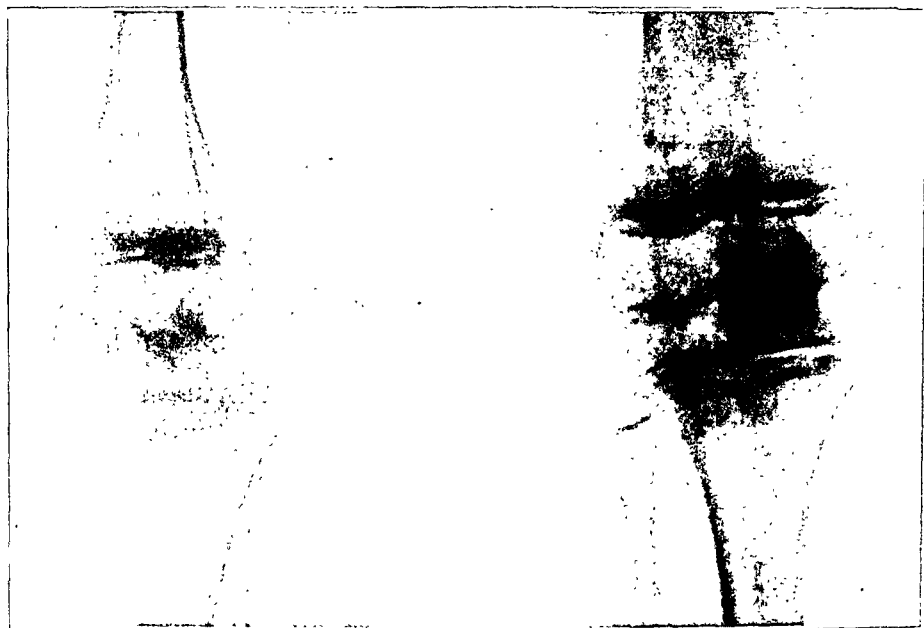


FIG. 4-D

S. B. Twelve months after operation, January 31, 1933.

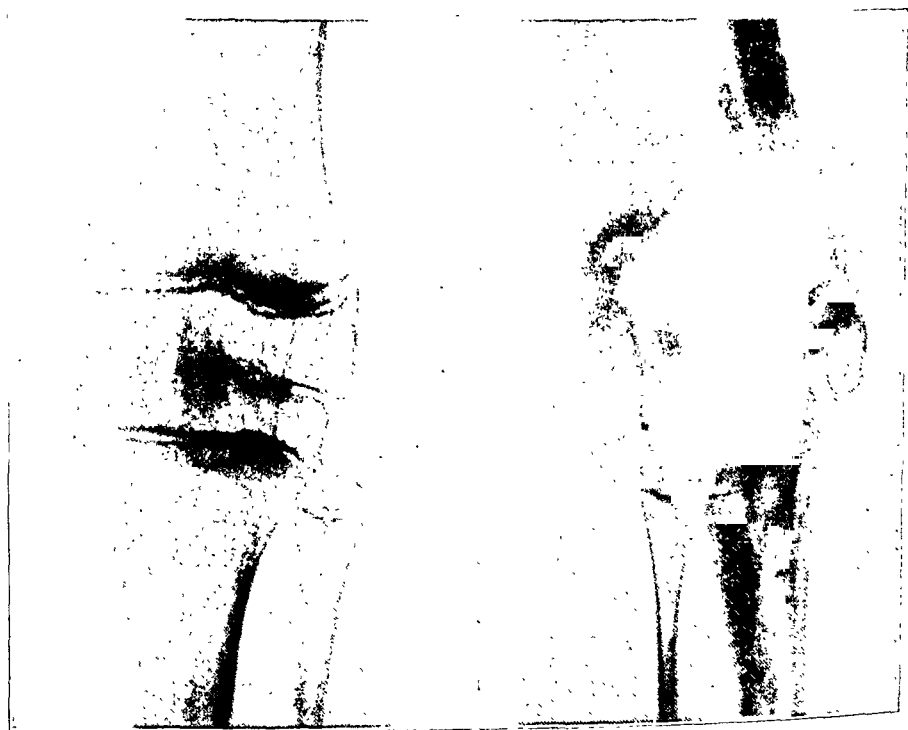


FIG. 4-E

S. B. Two years after operation, January 31, 1934. Note the normal appearance of the epiphyseal disc.



FIG 4-F

S B Six years and ten months after operation, October 1, 1938

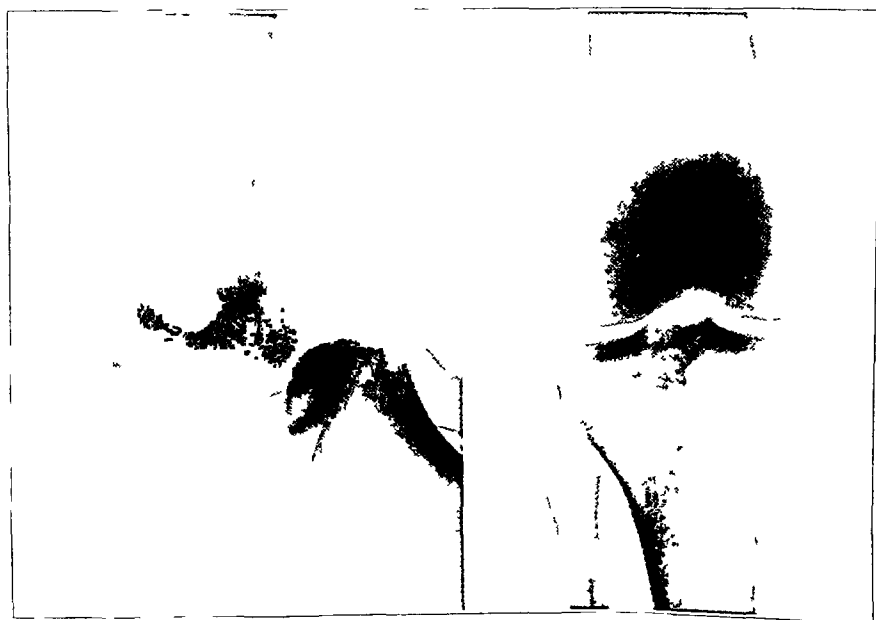


FIG 4-G

S B Right knee (normal), October 1, 1938 Note the comparative closure of the epiphyseal disc

TABLE I

COMPARISON OF THE RESULTS OBTAINED BY THE USE OF THE CENTRAL BONE GRAFT IN JOINT ARTHRODESIS WITH THOSE OF THE HIBBS TYPE OF FUSION

Central Bone Graft						
Patient	Hospital No.	Diagnosis	Age at Operation (Years)	Date of Operation	Age at Last Follow-Up (Years)	Amount of Shortening (Inches)
W. K.	1086	Tuberculosis	13	July 1929	20	0.00
A. R.	1142	Tuberculosis	12	September 1929	18	0.50
W. C.	390	Tuberculosis	6	November 1929	14	1.00
J. C.	1766	Tuberculosis	8	November 1931	13	0.50
S. B.	1642	Tuberculosis	9	December 1931	18	0.00
F. Mc.	811	Tuberculosis	7	February 1932	15	2.00
C. G.	2063	Osteomyelitis	14	September 1932	18	1.25
H. O.	1061	Tuberculosis	8	January 1933	14	1.25
P. I.	2272	Tuberculosis	11	April 1933	16	2.50
W. M.	2310	Tuberculosis	8	June 1933	14	0.50
			Average Age 9.6	Average Shortening 0.95		
Hibbs Type of Fusion						
J. M.	105	Osteomyelitis	13	September 1925	21	2.00
R. M.	493	Tuberculosis	7	March 1927	18	0.50
E. A.	298	Tuberculosis	5	August 1926	15	0.25
E. O.	542	Tuberculosis	6	June 1927	17	0.25
S. E.	573	Tuberculosis	13	July 1927	22	1.00
J. B.	599	Tuberculosis	13	August 1927	16	3.00
J. S.	631	Tuberculosis	13	October 1927	21	0.75
E. R.	903	Tuberculosis	11	October 1929	16	0.75
F. Mc.	1045	Osteomyelitis	6	October 1930	13	0.00
A. L.	1541	Tuberculosis	5	July 1931	11	0.25
			Average Age 9.2	Average Shortening 0.88		

graft fractured. The patella is then denuded and placed across the joint; the wound is closed in layers; and plaster is applied from the toes to the groin.

The plaster is changed and the sutures are removed at the end of eight weeks. To minimize epiphyseal slipping, the limb is protected by a brace for from three to four months in older children and for twelve months in the younger patients. Figures 4-A through 4-G show the results in one case.

#### COMMENT

The first application of this method to juvenile cases was made at the Shriners' Hospital in March 1929. We were not ignorant of the

disastrous effects on growth which follow damage to the epiphyseal disc, and this patient was observed for four months before three succeeding patients were operated upon. A two-year follow-up of these cases convinced us that penetration of the epiphyseal discs by a more or less *centrally* placed graft evidently did not materially disturb growth, but, of course, full confirmation could only result from observing a considerable group of cases through the entire growth period.

In 1932, Phemister presented his work on operative arrestment of longitudinal growth of bone, and, since his roentgenograms showed definite changes in the epiphyseal disc at the end of thirty-eight days and complete closure at the end of forty-three months, it became apparent even at that time that the central graft would not result in a similar arrestment of growth.

We offer in evidence the first ten cases of our series charted and checked against a similar number in which the Hibbs technique was used (Table I). Summarized briefly, the pertinent facts disclosed by comparison are:

1. The average age at operation was nine and four-tenths years.
2. Tuberculosis was the operative indication in the majority of cases.
3. The mean follow-up period was seven years.
4. The average amount of shortening was approximately one inch in both groups.
5. The age at operation apparently did not influence growth in this small series.
6. Dissemination of disease along the graft tunnel, which might happen theoretically, has not occurred in any instance.

Originally designed for the knee joint, the technique has been adapted to other major joints, and we are particularly happy over the results of its application to ankle-joint arthrodesis.

#### OPERATIVE TECHNIQUE AS APPLIED TO THE ANKLE JOINT

The chief surgical indication in this series was flail ankle, associated with weakness of the quadriceps femoris, in children between the ages of nine and fourteen years.

A linear incision (Fig. 5, A) is made over the tibial crest from the middle third to the neck of the talus. The bone is exposed subperiosteally; then the ankle joint is opened, and the capsule is freed and retracted. By means of a medium-sized curette with a rotary *back-and-forth* motion, the articular surfaces of the talocrural joints are destroyed, the osteocartilaginous chips being left *in situ*. The graft is removed from the tibia (Fig. 5, B); the tunnel through the tibial epiphysis and the neck of the talus is made (Fig. 5, C); and the graft is inserted (Fig. 5, D) in the case of the knee joint.

In all of these cases the operation has been done since 1932, and the growth record is incomplete, although the absence of demonstrable

growth disturbance in the cases in which the operation was performed on the knee joint may perhaps be taken as indicative that the procedure

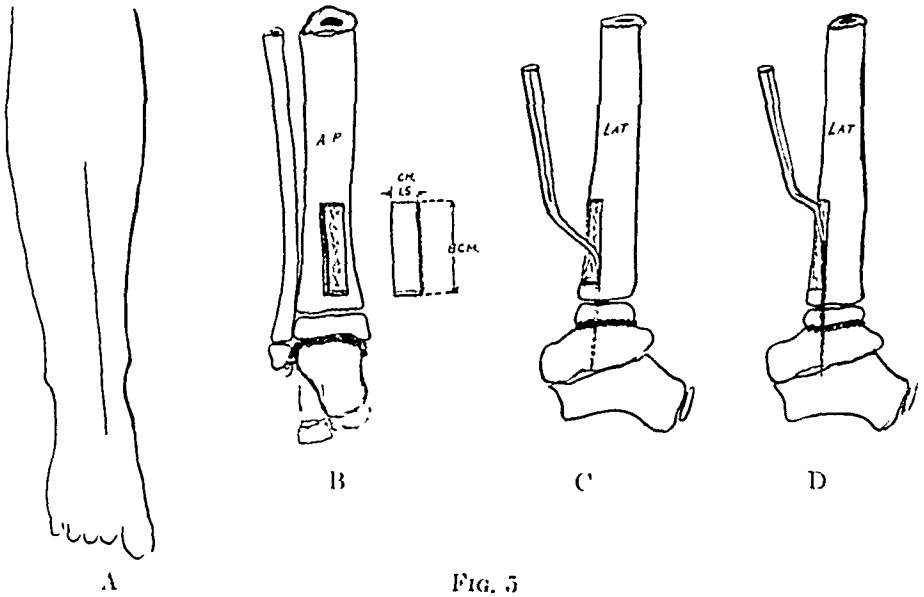


FIG. 5

- A: Incision.  
 B: Articular surfaces destroyed; graft removed.  
 C: Bayonet osteotome forms tunnel for graft.  
 D: Graft driven through tunnel with bone set.

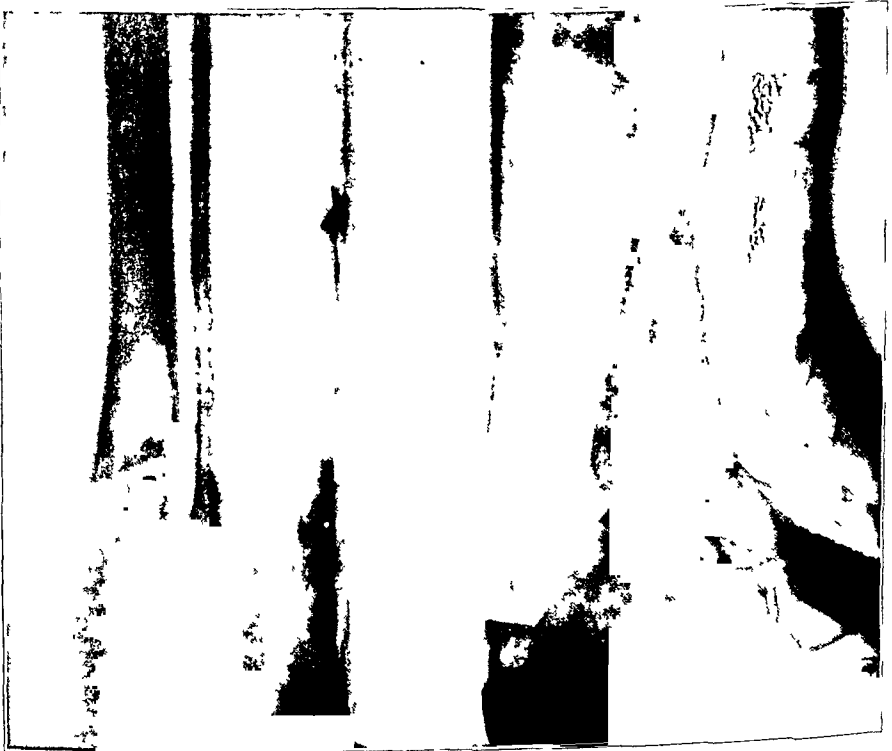


FIG. 6-A

P. H., aged eleven years. Old infantile paralysis. Right ankle after operation, February 24, 1936.

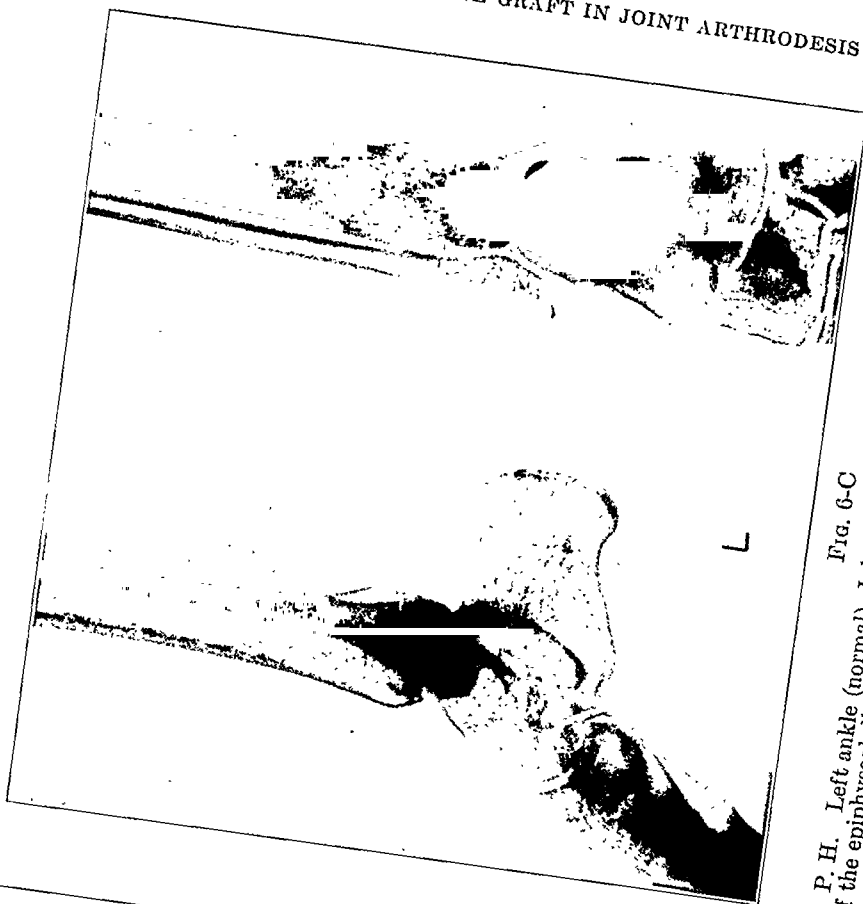


FIG. 6-C  
P. H. Left ankle (normal), July 8, 1938. Note the comparative closure

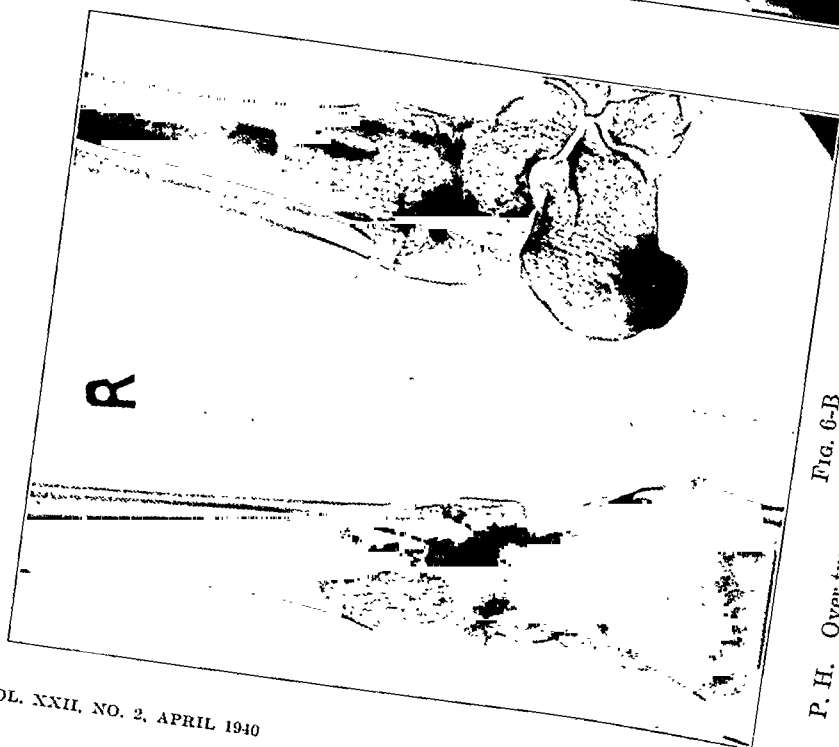


FIG. 6-B  
P. H. Over two years after operation, July 8, 1938.

will prove equally satisfactory in the ankle joint, where only one epiphyseal disc is involved. There have been no failures of fusion. In all cases treated by this method, the ankles were clinically solid within two months (Figs. 6-A, 6-B, and 6-C).

#### SUMMARY

By means of the method of securing fixation in joint arthrodesis which has been described, position and alignment are ensured and osteosynthesis is hastened. Growth arrestment does not occur from a graft passing through the epiphyseal plates at or near the *central area*.

The author is indebted to his former Residents, Dr. D. J. Killoran and Dr. P. C. Carson, for their assistance in the preparation of this brief article.

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# OSTEOSYNTHESIS PRECEDING EXTENSIVE BONE-GRAFTING

BY WILLIAM J. STEWART, M.D., COLUMBIA, MISSOURI

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Occasionally, patients are encountered who have sustained extensive loss of bone as a result of tumors, infection, or previous operations. One of the difficulties experienced in replacing this lost bone by a large graft is in securing adequate immobilization of the fragments. There are a number of ways of obtaining immobilization, but, when the involved bone is the tibia, the production of an osteosynthesis with the fibula is a simple procedure, which effectively immobilizes the two tibial fragments and further aids in securing stability of the lower leg.

This procedure was used in the following case in which sufficient time has elapsed to permit a reasonable estimate of the end result.

## CASE REPORT

A six-year-old boy was admitted on July 17, 1936, with a defect in the mid-portion of the right tibia, resulting from old osteomyelitis and previous operation to cure the infection. The leg was angulated somewhat, but the fibula was perfectly straight and somewhat larger than normal (Fig. 1).

On July 20, 1936, an osteosynthesis of the two fragments of the tibia to the shaft of the fibula was performed, the grafts being placed inside the epiphyseal line, so as not to interfere with growth. The grafts united firmly (Fig. 2).

On October 1, 1936, a massive bone graft was inserted in both fragments of the tibia in slots prepared to receive it. A plaster cast was applied, and no other fixation of the graft to the tibial fragments was used.

Weight-bearing with crutches was started in January 1937 (Fig. 3), and crutches were gradually discarded. Full weight-bearing was begun on February 11, 1937.

The child was next admitted in September 1939. Roentgenograms were taken at that time (Fig. 4). Because of shortening of the right leg, an epiphyseal arrest on the opposite leg was performed in order to equalize the length of the legs.

A massive bone graft was inserted into the site of the defect in the tibia after an osteosynthesis of the two tibial fragments to the fibula had been performed. The graft remained *in situ* without any additional fixation, such as wires, pins, etc., and full weight-bearing was started approximately seven months after the first operation.

The leg is perfectly solid, and growth has not been interfered with, since the operations were performed inside the epiphyseal lines in all instances.



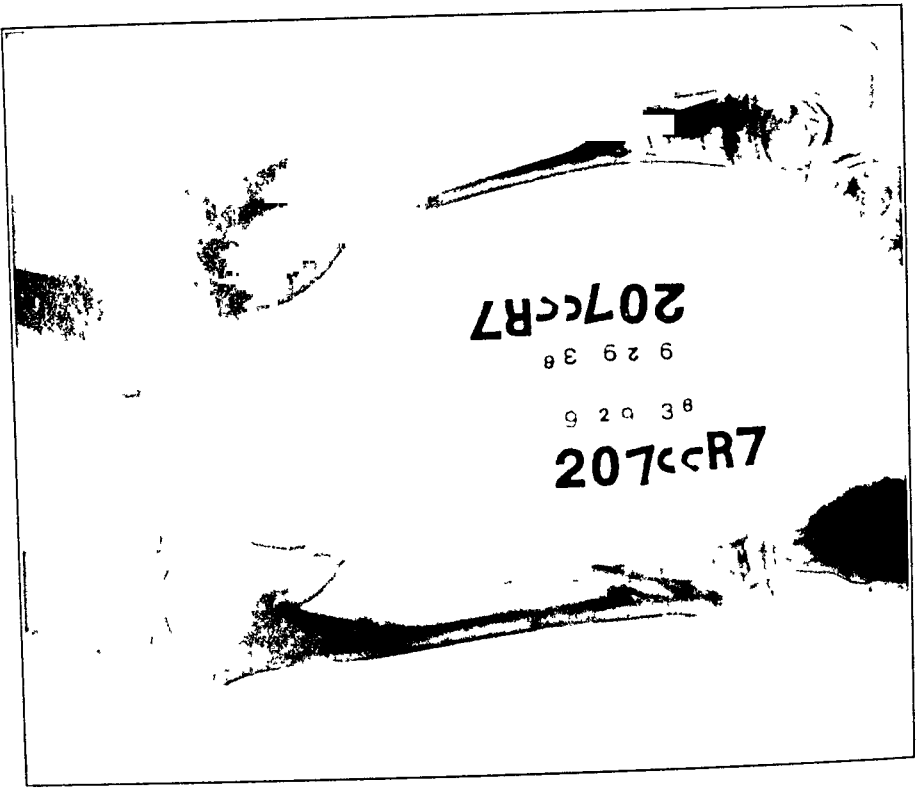


Fig. 2

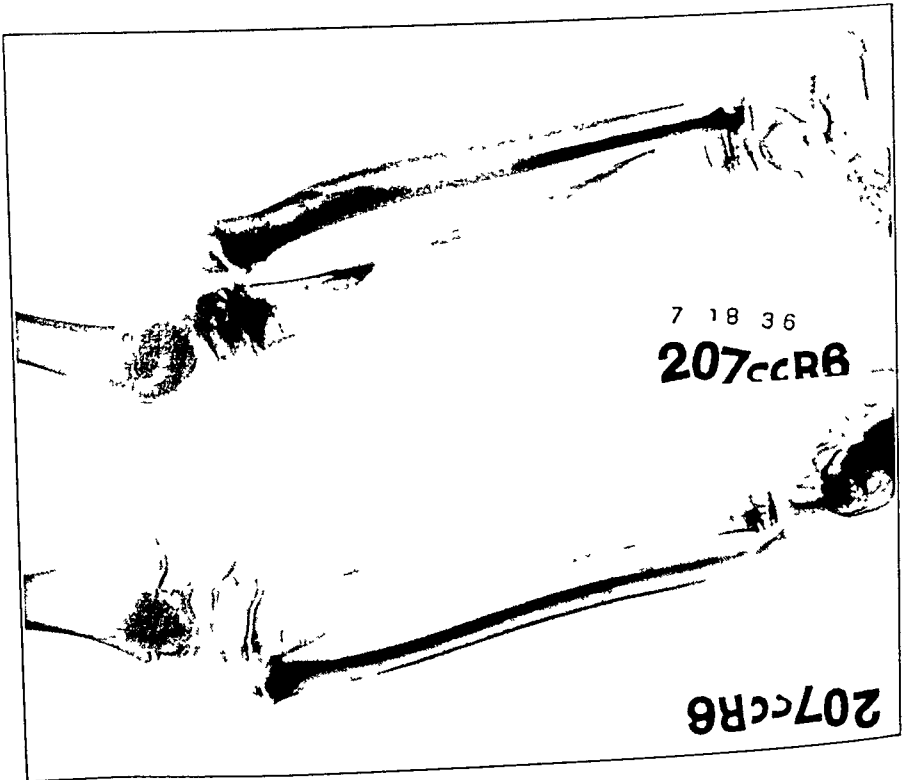


Fig. 1



# THE KINESIOLOGICAL LEVER IN RECONSTRUCTION OPERATIONS ON THE HIP\*

BY FRED H. ALBEE, M.D., F.A.C.S., F.I.C.S., NEW YORK, N. Y.,  
AND VENICE, FLORIDA

Although the author has applied the kinesiological principle involved in restoration of the hip joint and active weight-bearing function for over twenty years in cases of non-union of the femoral neck, it was not until February 1939 that he published a paper<sup>1</sup> dealing primarily with the principle itself.

The kinesiological mechanism consists of a lever—femoral head, neck, and greater trochanter—with associated muscles pulling upon its distal end. These muscles are seven in number: the gluteus medius and minimus, the obturator externus and internus, the gemellus inferior and superior, and the piriformis. If the lever is shortened, or if the muscles are weakened, normal function is interrupted. The phenomenon of muscle control and the basis of all skeletal motion for any joint rest upon this same principle.

There is only one other region where the element of the lever is so apparent, and that is at the olecranon process. In the instance of the elbow, however, only one muscle is involved.

The likelihood of interference with any element of this coordinative action rests with the lever and not with the muscles. By the same token, the function of internal and external rotation is restored by the lengthening or restoration of the lever. There is no more likelihood of interruption of muscle function in the hip than in any other region, but the proximity of the lever to the joint means that in any extensive involvement of the joint by disease, etc., the lever is likely to suffer. It should be borne in mind that in the kinesiological mechanism of the hip abduction is at a marked disadvantage and is much more liable to interference or weakening than any other motion, particularly since it is the only motion that involves weight-bearing. In the case of adduction, however, even extensive involvement of the hip joint will not disturb the lever, because its make-up consists of long muscles originating from the central portion of the pelvis and inserted into the femur at a considerable distance below the hip joint itself. Therefore, adduction function is likely to be affected only by the interference with muscle strength, such as results from infantile paralysis, etc. In short, at the same time that the abductors are worked against by weight-bearing, the adductors are favored by the same influence.

In this respect, the mechanics of the Albee reconstruction operation on the hip may be elucidated by a description of the mechanical action of the reconstructed hip lever.

\* Read in part at the Annual Meeting of the American Academy of Orthopaedic Surgeons, Memphis, Tennessee, on January 19, 1939.

In this operation, the insertions of the short trochanteric or abductor muscles are carefully left intact on the greater trochanter or distal end of the lever. As the approach to the hip does not interfere with their innervation, the ability to abduct, lost with the leverage action of the neck of the femur, is restored.

The lever is immediately lengthened by the placement of the wedge\*, and, when the leg comes to the mid-line, the outward excursion of the distal end of the lever causes the trochanteric muscles and the surrounding soft parts to become tense, and thus prevents dislocation. Likewise a mechanism is established for the favorable function of the muscles involved in weight-bearing and in abduction. In this way, the newly formed femoral head is held firmly in the acetabulum and is prevented from riding on the rim of the acetabulum or from shifting its location,—a postoperative condition which often causes bone absorption and pain. Consequently, a limp is diminished or overcome in direct relation to the weight-bearing and abduction efficiency.

One of the principal objectives of the Albee reconstruction operation is to provide a mechanism to reestablish weight-bearing and locomotive stability to as near the normal as possible.

In considering the design of a reconstruction operation and its virtues, a study of the comparative anatomy of the upper end of the femur of the ox and of the horse is very suggestive and interesting in view of the high locomotive stability of these animals.

In the human femur, the hip lever normally has five parts,—three on the inside of the weight-bearing axis of the femoral shaft and two on the outside. In the ox, one of the most stable of all animals, if the lever is divided into six parts, two are on the inside of the weight-bearing axis and four are on the outside of the axis (Fig. 1).

\* A rectangular or square graft of proper size may be obtained from the anterior upper portion of the outer table of the ilium. The ilium is a very satisfactory source of bone-graft material in most cases, except in non-union of the femoral neck, when the femoral head serves so well, or where the muscles are already weak and further damage to them is significant. In the latter instance, the anterior internal surface of the tibia at its upper portion is more desirable.

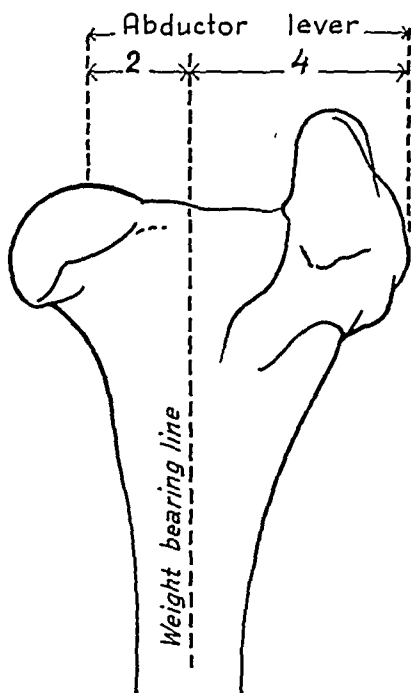


FIG. 1

Drawing from a roentgenogram of the femur of an ox. Note that the kinesiological lever has been divided into six parts, of which two are on the inside of the weight-bearing line and four are on the outside. In the human femur, the lever has five parts, three of which are on the inside of the weight-bearing line and two are on the outside.

A well-known mechanical engineer, Mr. E. H. Hull, was engaged to determine the mechanical reasons for the high locomotive stability of these animals, as well as the relative values (from the same standpoint) of the various reconstruction operations. Mr. Hull industriously studied, from mechanical models, the features involved in the hip-joint stability of the ox, the horse, the rabbit, the cat, the pig, the mastodon, and the mammoth.

He observed that, without altering the length of the kinesiological lever, the abduction and weight-bearing stability increased when the muscle insertions at the tip of the greater trochanter approached the level of the top of the femoral head, which is the fulcrum point of the lever. The lever substitution for the femoral neck is situated outside of the long axis of the femoral shaft, precisely as it is in the ox and in many other animals. The stability of the hip is not only restored, but active inward and outward rotation are reestablished as well.

Mr. Hull estimated that the superior results (from the standpoint of stability) obtained in the Albee reconstruction operation, as compared with results of the Whitman and the Colonna methods, were apparently due solely to the mechanical superiority and the proportionately increased length of the kinesiological hip lever. Mr. Hull's measurements and deductions were made from numerous roentgenograms from the publications of the various author-designers.

In both the Whitman and the Colonna operations, the insertions of the muscles involved in abduction and in weight-bearing are on the side of the femoral shaft. This is particularly true in the Colonna operation, and, together with the complete destruction of the hip lever, takes away most of the stabilizing, weight-bearing, or rotary influence which the trochanteric muscles exert upon the limb under normal conditions.

In a number of cases, a comparative study of the beneficial influence of restoring the length of the hip lever—when completely or partially destroyed from a variety of causes, or when lengthened beyond the normal, due to weakening of the muscles—has been very impressive.

The variety of conditions to which this principle has been applied, and in which the results have been checked, has been great. There have been some cases of tuberculosis, or of other destructive lesions, with varying amounts of bone destruction and preservation of a worth-while range of motion. In such cases, the kinesiological lever has been so shortened that the limb persistently swings into fixed adduction with resultant practical shortening and faulty locomotion. The correction of this deformity was formerly accomplished by the author—and, he believes, quite generally by his confreres, even at the present time—by an arthrodesis of the hip joint. It was found that correction by Gant's osteotomy, with the objective of preserving motion, was sure to cause relapse, due to the inadequacy of the abduction mechanism, as opposed to the intact adduction mechanism. The author has found it possible to effect a permanent correction of the adduction deformity and to preserve the full range of

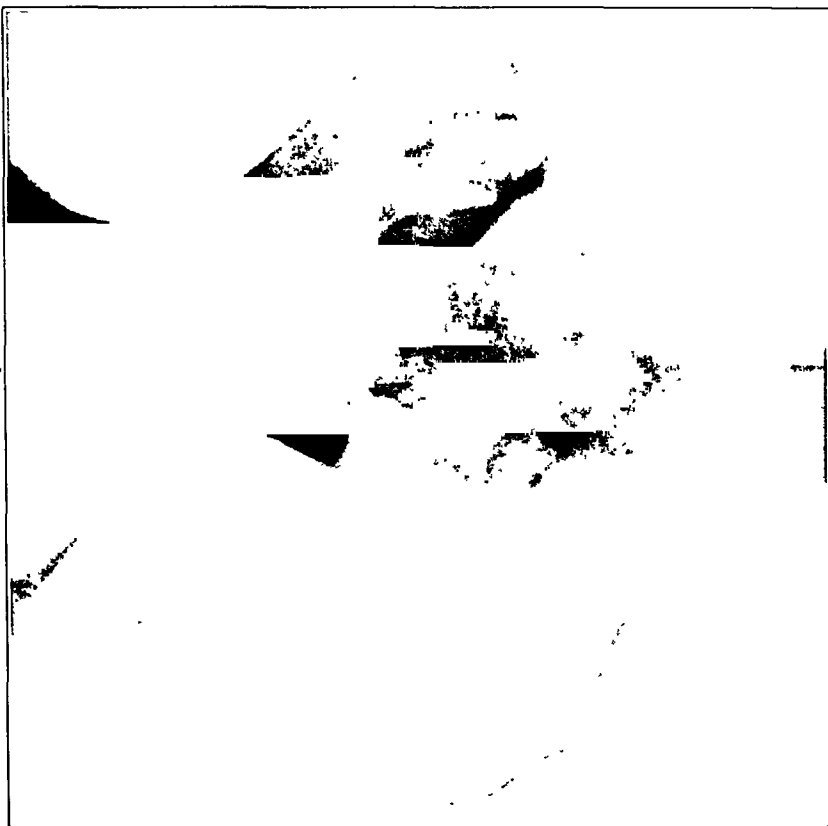


FIG. 3

Roentgenogram showing postoperative result in same case as in Fig. 2. The bone block has been relieved, and the lever has been markedly lengthened by displacement of the greater trochanter outward. A rectangular graft from the outer table of the ilium of the same side has served to hold the trochanter in its outward position, as well as to fuse it to the upper portion of the femur.

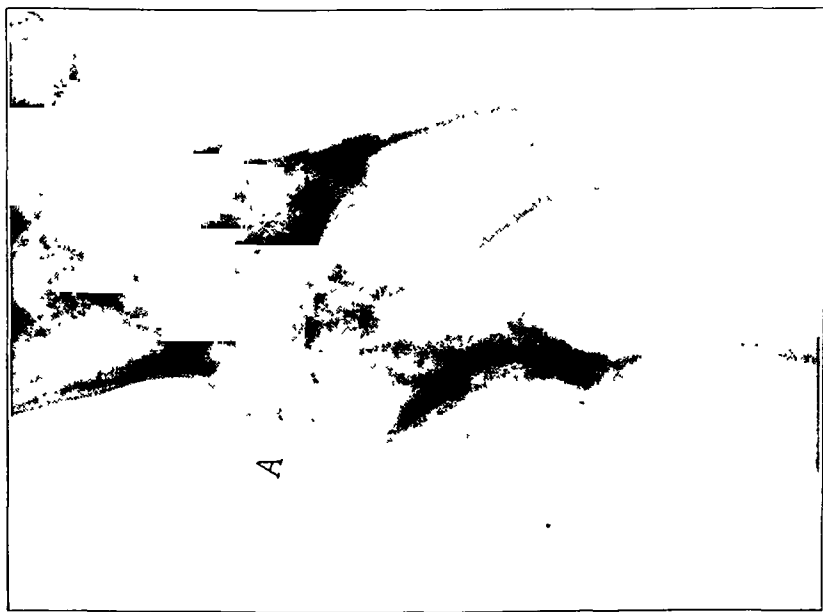


FIG. 2

Roentgenogram showing marked congenital shortening of the kinesiological lever with a pronounced bone block to abduction at A.

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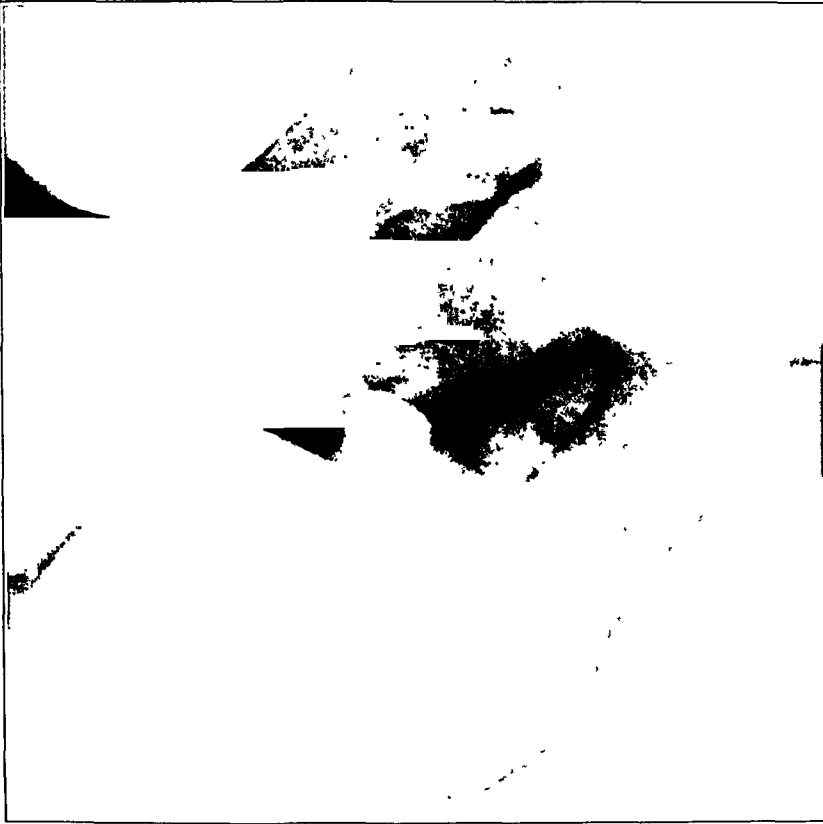


FIG. 3

Roentgenogram showing postoperative result in same case as in Fig. 2. The bone block has been relieved, and the lever has been markedly lengthened by displacement of the greater trochanter outward. A rectangular graft from the outer table of the ilium of the same side has served to hold the trochanter in its outward position, as well as to fuse it to the upper portion of the femur.



FIG. 2

Roentgenogram showing marked congenital shortening of the kinesiological lever with a pronounced bone block to abduction at A.





FIG. 4

Roentgenogram of the hip in a case of infantile paralysis, demonstrating the elongation of the kinesiological lever beyond the normal by a rectangular graft taken from the outer table of the ilium.

motion by restoring functional muscle balance by the elongation of this lever.

For the same reason, it has been found most beneficial to lengthen the lever, especially when shortened in congenital deformities such as dislocations (Figs. 2 and 3), or following arthroplasty of the hip for restoring motion, or in old cases of healed epiphysitis with complete loss of the femoral head and neck. In such instances, the restoration of this lever serves a double purpose: it not only restores the function of active abduction and weight-bearing, but it prevents the upper end of the femur, when placed at operation in the acetabulum, from dislocating.

In seven of the author's cases, dislocation had followed other types of

reconstruction and arthroplastic operations which had been performed for restoration of function previous to treatment by the author. In every case, relief was afforded and dislocation was prevented by the restoration of the lever. In cases where the abduction musculature is weakened, particularly from infantile paralysis, the lever is elongated beyond its normal anatomical length, in order to afford greater leverage advantage for the weakened muscles (Fig. 4).

A very helpful application of this principle has been to those cases in which motion has been restored by operation when the kinesiological lever has been shortened by the lesion which produced the ankylosis, and added to by bone removal at the mobilizing operation. This secondary step may be done at the primary mobilizing operation, or at a later date when attempts at function have proved it necessary.

Voluntary effort and cooperation on the part of the patient are very important in the development of motion and a useful joint after an arthroplastic operation at the hip. Therefore, it would seem unnecessary to emphasize the importance of an early reestablishment of the kinesiological mechanism of active function. The increased efficiency of weight-bearing and of abduction following lengthening of the lever results in a much better gait, usually eliminating the positive Trendelenburg sign, which so many of these patients have.

The choice between this operation and the bone-peg operation in non-union of the femoral neck is determined by the amount of neck absorption of the fragments. In some borderline cases, the selection of the type of operation cannot be made until the neck and head of the femur have been exposed at operation. In many cases, roentgenograms have indicated the capital fragment to be of sufficient length to receive a bone peg, but, when exposed at operation, the fractured end has been found to be hollow, with a marked cup-shaped depression, and unsuited to receive a graft. The range of painless motion following the author's operation has been most satisfactory, and, in a large percentage of cases, 90 per cent. of normal motion has been restored.

It should be stated, however, that the amount of motion is not the sole yardstick in determining the desirability of the operative results. Maximum stability with motion, including inward and outward rotation, weight-bearing, strength and endurance, as well as absence of pain, are all equally important, and are largely dependent on the successful restoration of the kinesiological mechanism.

The following case is an excellent illustration of the application of the kinesiological principle.

Miss H. H., aged thirty-two, was first seen by the author on July 11, 1924. She stated that she had suffered from ankylosis of both hips, apparently the result of suppurative arthritis. In 1917 an arthroplasty had been performed on the left hip, and in 1919, on the right hip. Excellent motion was obtained in both hips, but the result of the operation on the right hip was a serious disappointment to the patient. She felt that she would much prefer the stiff hip that she had had prior to operation, because there was constant

danger of dislocation whenever the limb came to the mid-line. Moreover, the function of abduction and of active weight-bearing had been lost.

The right hip, therefore, was operated upon by the author on July 14, 1924. The newly formed joint resulting from the previous arthroplasty was found to be an excellent false joint, with a well-formed acetabulum, containing clear fluid closely resembling synovia. The femoral portion of the hip consisted merely of the stump of the femoral neck. The kinesiological lever was restored on the outer side of the long axis of the femur by the author's usual technique, but, instead of a massive graft, numerous small grafts were used to build up the lever.

In May 1925, the patient sent roentgenograms showing complete union and successful construction of the desired lever. She wrote that the hip had not dislocated, and that she considered the result excellent.

The summation of the whole matter is that this principle has been used with satisfaction in the following types of cases:

1. Pseudarthrosis of the femoral neck with marked bone absorption, in 437 cases over a period of twenty-one years.

2. Following restoration of motion from arthroplastic operations where this lever had been markedly shortened, in seventeen cases over a period of fifteen years.

3. Old cases of epiphysitis with loss of femoral head and neck, in six cases.

4. Congenital malformation in congenital dislocation, to prevent redislocation, etc., in three cases. In one of these cases, the operation served two purposes, because the shortening of the neck was so great that abduction was prevented by the bone block produced by the impingement of the tip of the greater trochanter against the side of the ilium. The displacement of the trochanter outward overcame this.

5. Healed tuberculosis followed by worth-while motion, in two cases.

6. Infantile paralysis where the abductor and rotator muscles had been weakened, in nine cases over a period of six years. In one of these cases, the bone graft slipped partially out of position, and the result was not completely successful.

1. ALBEE, F. H.: Reconstruction of Top of Femur (Lever) or Its Elongation in Paralytic Conditions. *Am. J. Surg.*, XLIII, 416, 1939.



FIG. 1

Anteroposterior and lateral roentgenograms showing the fracture of the shaft of the humerus with 180 degrees of rotation of the lower humeral fragment both in relation to the upper fragment and to the radius and ulna. The medial epicondyle is opposite the lateral condyle.

satisfactory alignment. The right upper extremity was immobilized in a plaster shoulder spica.

Therapeutic doses of 20,000 units of tetanus antitoxin and 20,000 units of gas-bacillus antitoxin were administered intramuscularly on the second postoperative day.

On the fourth day following operation, cultures from each wound revealed a light growth of staphylococcus aureus and bacillus welchii. However, there was no clinical evidence, generally or locally, of such an infection at any time, and conservative treatment was followed.

On the thirteenth day after operation, the shoulder spica was removed, and the wounds were found to be healed without infection. A long arm plaster cast was applied and was strapped securely to an aeroplane splint.

Postoperative roentgenographic examination revealed good position of all fragments save for mild angulation (Fig. 2).

Six weeks after the injury the radial-nerve palsy had entirely disappeared, but there was an ulnar-nerve palsy in the hand, as well as continued hypaesthesia in the distribution of the median nerve in the hand. The function of the median and ulnar nerves gradually returned and was normal eight months following operation.

The immobilization of the humerus was continued for six months. In spite of good apposition of the fragments and quite complete immobilization, this fracture failed to unite. A further complication was the development of a draining sinus in the compound wound over the medial aspect of the upper arm. This sinus drained small amounts of purulent material intermittently for fourteen months postoperatively.

At the fifth postoperative month, the forearm was found to be fixed in 20 degrees of supination, and the elbow was clinically ankylosed in 70 degrees of flexion. In spite of physiotherapy, fixation of these joints persisted. Later roentgenographic examination revealed evidence of cross union between the radius and the ulna and of bony ankylosis at the elbow joint, particularly about the lateral side of the radiohumeral joint.

After the sinus had remained healed for eight months, an open reduction of the non-union fracture of the humerus was performed.

The fragment ends were sclerotic, and there was a definite pseudarthrosis between them. The sclerotic bone ends were removed, and the fragments were drilled. Reduction was maintained by stainless-steel-wire fixation between the fragments and by a massive tibial onlay graft fixed to each fragment by wire loops.

There was no postoperative complication, the wound healing by primary intention. The humerus was immobilized in a plaster spica for four months after operation, when roentgenographic examination revealed solid bony union in excellent position and well-advanced incorporation of the bone graft (Fig. 3). The epiphyseal lines of the lower end of the humerus and the upper ends of the radius and the ulna had become obliterated. Eight months following the open reduction, examination revealed a normal shoulder, wrist, and hand. The appearance of the forearm and the elbow was as already described. The humeral fragments were solidly united without evidence of infection. There were three inches of shortening in the upper arm and one and one-half inches of shortening in the forearm. The patient was well satisfied with the result and had good function of the extremity.

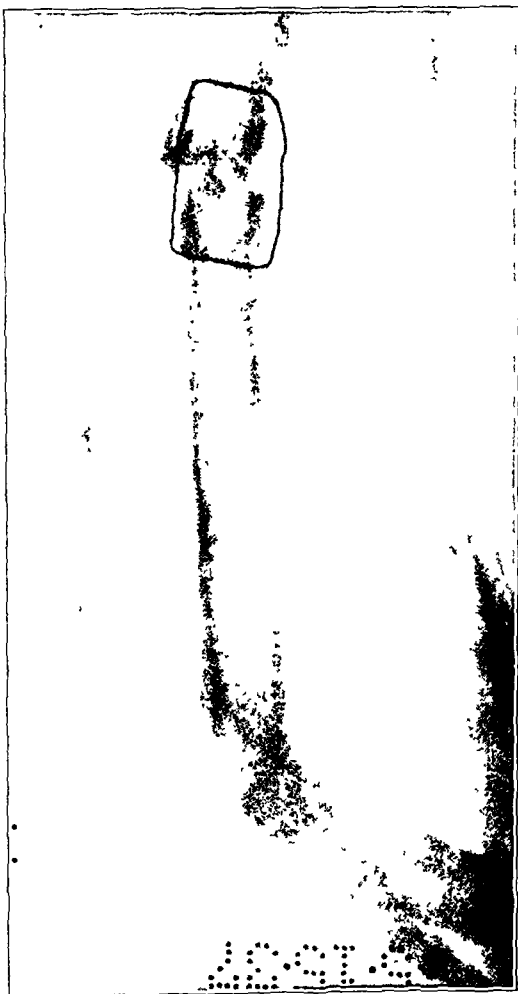


FIG. 2

Postoperative lateral roentgenogram of the humerus and elbow joint demonstrating the reduction and fixation of the lower humeral fragment.



FIG. 3

Twenty-six months following the original injury and four months after open reduction and bone-grafting. The humeral fracture shows bony union, and the bone graft is well incorporated. The epiphyseal lines about the elbow are obliterated, and there is a bony and fibrous ankylosis present in this joint.

Outside of the multiple fractures and nerve involvement of the right upper extremity, the unusual feature of the case was the 180-degree rotation of the lower humeral fragment, both in relation to the upper humeral fragment and to the radius and the ulna. The mechanism of the rotation at the elbow joint is difficult to explain. It was, apparently, an intracapsular rotation with maintenance of the medial epicondyle in a relatively normal position by its capsular attachments. Undoubtedly, the severe trauma acting upon this joint resulted in a solid bony and fibrous ankylosis and obliteration of the regional epiphyseal lines. The non-union of the humeral fracture was probably due to the compounding, the marked damage to bone and soft tissues, the infection at the site of fracture, and incomplete immobilization offered by a long arm cast resting upon an aeroplane splint. The complete return of nerve supply to the hand was fortunate. The result is entirely satisfactory except for the ankylosed elbow, for which arthroplasty will be considered later.

## SUBPERIOSTEAL GIANT-CELL TUMOR

BY W. J. POTTS, M.D., OAK PARK, ILLINOIS

*From the West Suburban Hospital, Oak Park*

This case of subperiosteal giant-cell tumor of the mandible is reported because the tumor is unusual in type and unique in its point of origin.

T. J., male, aged six years, came under the author's observation on June 21, 1937. Approximately two weeks earlier the child's mother had suddenly become aware of a rather marked swelling at the angle of the right jaw and below the ear. Because one of the neighbor's children had mumps, the patient's mother made a similar diagnosis and treated the condition accordingly. The swelling failed to subside. The boy recalled that shortly before the appearance of the swelling he had been hit on the jaw with a baseball. He could not remember whether the swelling had followed immediately or within a few days. The past history was irrelevant.

**Physical Examination:** The patient was a vigorous boy in seemingly good health. The general physical examination revealed no variation from normal except that at the angle of the right mandible there was a smooth, round, hemispherical swelling, the size of a small orange (Fig. 1). It was slightly tender, very hard, and firmly attached to the underlying structures. The lobe of the ear was pushed outward slightly. The head was held inclined a little toward the left. No regional lymph glands were palpable. The tonsils appeared to be normal, and there was no caries of the teeth.

**Laboratory Examination:** Examination of the urine was negative. Routine examination of the blood showed no variation from normal. The Wassermann and Kahn tests were negative for syphilis. The sedimentation time was two and one-half hours.

**Roentgenographic Examination:** The report of the roentgenographic examination by Dr. Frank Ronayne was as follows:

"The anteroposterior roentgenogram shows marked swelling of the soft parts of the right side of this patient's jaw. There is a slight amount of bone destruction along the outer border of the right side of the mandible at the level of the uninterrupted second molar. The lateral roentgenogram [Fig. 2] shows an irregular, poorly circumscribed area of bone destruction along the inferior border of the mandible at the junction of the ramus and the body. **Conclusion:** This examination reveals evidence of osteitis, osteomyelitis, or possibly a malignant bone tumor."

**Biopsy:** Because of the uncertainty of the diagnosis, a needle biopsy was performed. The skin over the tumor was infiltrated with novocain, and an 18-gauge needle was inserted. With a syringe, old blood and some fresh blood were

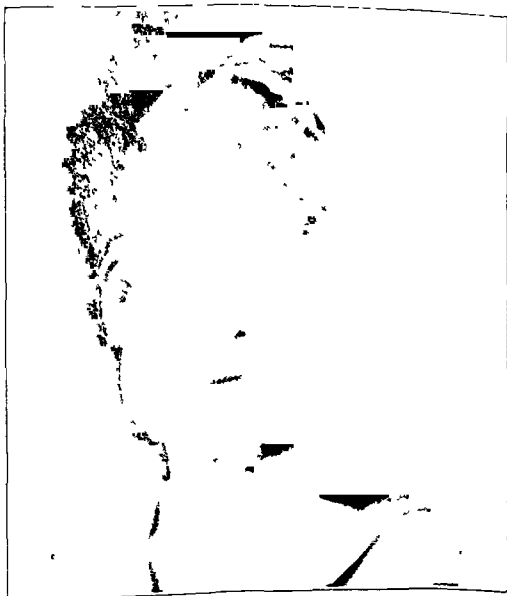


FIG. 1

Photograph showing size and location of tumor.

aspirated. The needle was twisted about a number of times in the hope of dislodging a fragment of tissue. From the material aspirated, Dr. Eugene Piette, pathologist, isolated a small piece of tissue, which he stained with hematoxylin and eosin. Microscopic examination revealed a small nest of giant cells in a matrix of fibrous tissue. A tentative diagnosis of giant-cell tumor of the mandible was made.

*Operation:* Under ether anaesthesia, an incision was made through the skin from the lobe of the ear along the curve of the mandible to the external maxillary notch. A definite fibrous capsule of bluish hue covered the mass. The soft tissues were easily dissected from this capsule. The masseter-muscle fibers attached to the capsule were cut. The facial nerve was isolated and retracted upward. The carotid sheath was freed from the mass and retracted posteriorly. The tumor *in situ* resembled in shape a mushroom with a very short, thick stalk. It was easily removed from the mandible with a chisel. The surface of the bone from which the tumor was removed appeared normal. Nothing but fine pieces of grossly normal bone could be removed with a curette. The wound was closed without drainage and healed *per primam*.

*Result:* For a few days there was drooping of the right lower lip. This disappeared spontaneously. The boy has remained well and has shown no sign of recurrence two and a half years after the operation.

*Roentgenographic Examination of the Specimen:* The roentgenograms (Fig. 3) showed a shell of bone covering all of the tumor except a small area at the base. Throughout

the specimen there were irregular shadows suggesting bony striations. The absence of demonstrable bone in the earlier roentgenograms and its presence in this specimen were easily accounted for by the two-week interval between the examinations.

*Pathology:* Gross examination of the tumor (Fig. 4) showed a definite fibrous capsule beneath which lay a thin sheet of bone, varying in thickness from barely discernible fragments to two and three millimeters. The base—that is, the point of attachment to the mandible—measured three centimeters in diameter; the tumor at its largest circumference measured five centimeters in diameter. The surfaces made by cutting the tumor in half showed masses of dark reddish-brown debris, interspersed with irregular areas of gray fibrous tissue. Throughout the entire tumor there were small



FIG. 2

Roentgenogram showing a small area of bone destruction at the angle of the jaw.



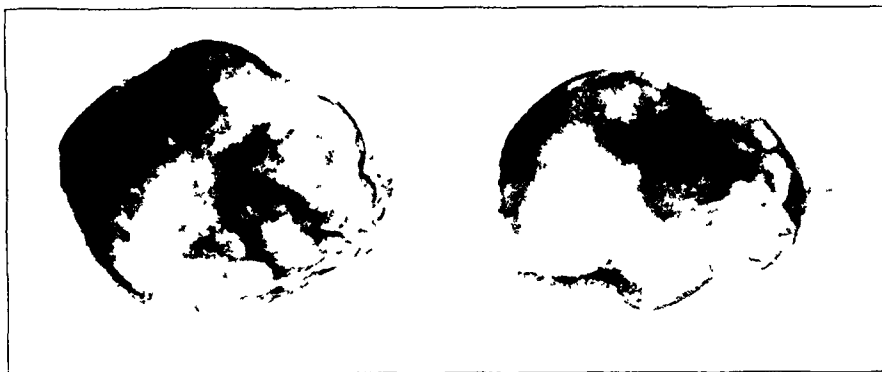


FIG. 3  
Roentgenograms of removed tumor.

areas of bone, which became denser toward the periphery. The entire mass was so friable that it was badly fragmented during cutting.

Microscopic examination of the tissues stained with hematoxylin and eosin and Mallory's connective-tissue stain (Fig. 5) show that the fibrous capsule was highly vascular. Beneath it there was irregularly formed adult bone. In one portion of the tumor there were large thin-walled vascular spaces, some of which were separated by only a narrow, thread-like wall. Throughout the tumor there were whorls of adult and embryonic connective tissue. Occasionally the fibrous tissue was homogeneous, resembling very slightly the architecture and structure of bone trabeculae. Disseminated in this tissue were numerous multinucleated giant cells. Small irregular areas of bone trabeculae were scattered through all the sections examined.

#### COMMENT

A careful review of the medical literature has revealed no previous report of subperiosteal giant-cell tumor of the skull or of the jaws.

Geschickter and Copeland<sup>1</sup> have stated that giant-cell tumors arise only in bone which is preformed in cartilage. To support this view they have cited twenty-two cases of giant-cell tumor of the skull or of the jaws, all of which arose from those portions of bone which were preformed in cartilage. They have predicted that, since the periosteum has osteoclastic activities, any giant-cell tumor arising from bone preformed in mem-

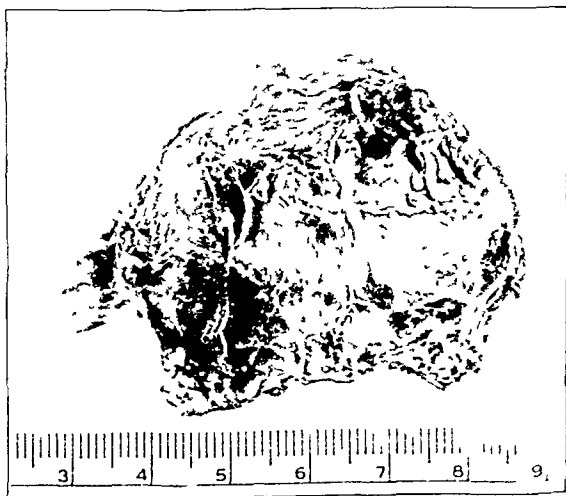


FIG. 4  
Gross specimen.

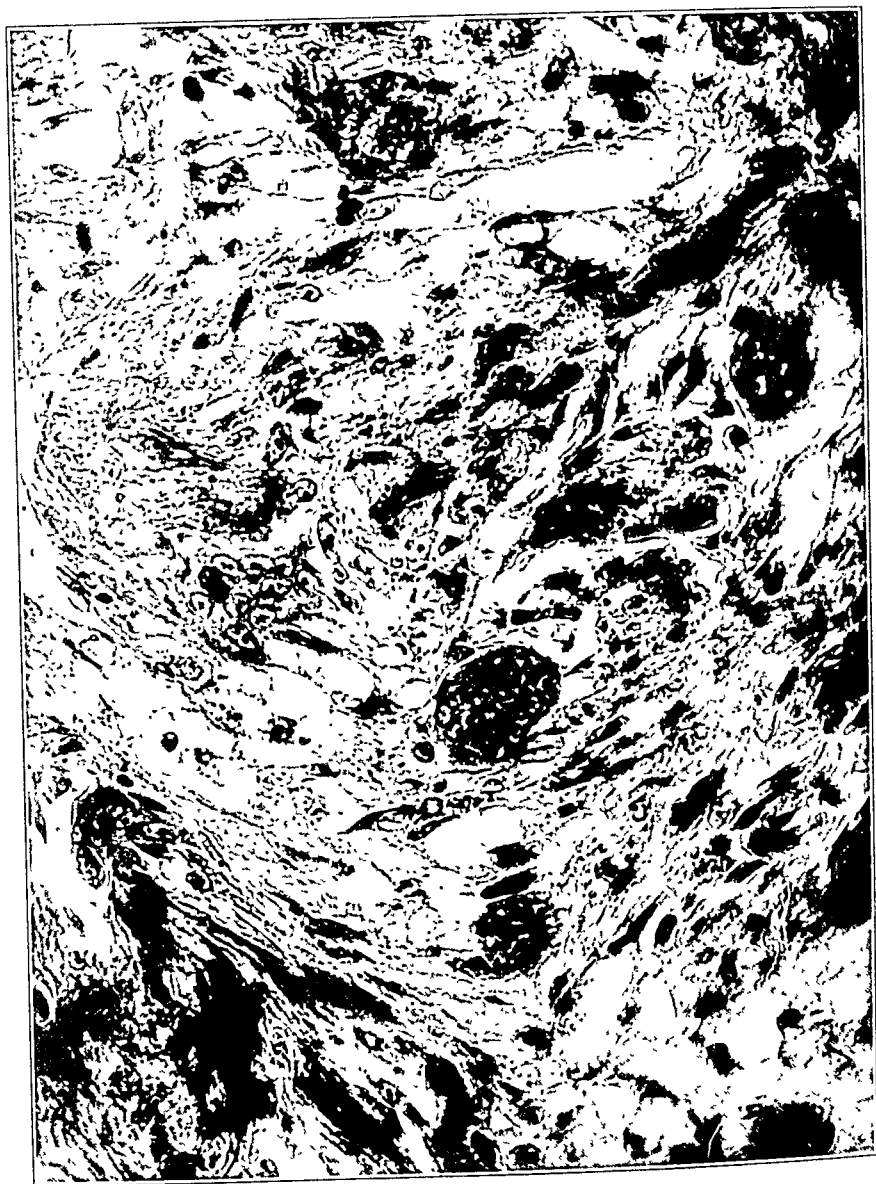


FIG. 5

Photomicrograph taken from slide stained with Mallory's connective-tissue stain. Irregular areas of bone, fibrous tissue, and giant cells are seen.

brane should be subperiosteal. Their prediction is fulfilled in the case herewith reported.

1. GESCHICKTER, C. F., AND COPELAND, M. M.: Tumors of Bone. New York, The American Journal of Cancer, 1931.

# UNUSUAL TARSAL INJURIES \*

## A REPORT OF TWO CASES

BY HOMER L. SKINNER, M.D., F.A.C.S., BALTIMORE, MARYLAND

*From the United States Marine Hospital, Baltimore*

In reviewing the literature, one finds the terminology of tarsal injuries sometimes confusing. According to Milch, the term "subastragaloid" should be reserved for those cases in which the astragalocalcaneal ligaments, as well as one or both of the mediotarsal ligaments, have been torn, but in which the tibiotarsal ligaments have remained intact. "Mediotarsal" should be applied only to those cases in which it can be demonstrated that both the calcaneocuboid and the astragalonavicular joints have been luxated, while the other tarsal and metatarsal joints bear their normal relationship to each other. Isolated dislocations should be considered as a separate type rather than as partial mediotarsal dislocations.

The exact mechanism in dislocations of the astragalus and in mediotarsal injuries is rather vague. Since the astragalus is the key bone about which all important motions of the tarsus center, Milch feels that one can better understand the type of injury if the astragalus is considered the active force instead of regarding the forefoot as the prime factor. A review of the anatomy and physiology of the astragalus and a consideration of the position of the joint and the direction of force at the time of injury suggest a hypothetical mechanism.

### SYMPTOMS

In mediotarsal dislocations the joint is shortened, swollen, and held in a fixed varus or valgus position. The head of the astragalus is prominent and tender. There is a depression in the area of the navicular. The usual history is that of a severe wrenching of the foot, following a fall from a moderate height. In dislocation of the astragalus the injury is usually severe and is the result of an external force, although Mitchell has reported a case due to the patient's falling down three or four steps. In this case the heel of the patient's shoe apparently caught on the step, causing marked plantar flexion, and the weight of her body forced the astragalus out anteriorly. The astragalus may be dislocated in any one of five positions: (1) medial; (2) lateral; (3) anterior; (4) posterior; and (5) rotary.

### REPORT OF CASES

CASE 1. H. W. S., aged thirty-six, a seaman, on December 22, 1936, fell from thirty-five to forty feet from a ladder into the water below. On the way down he struck his left

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ankle and foot on the side of a projecting piece of wood. He was treated in two hospitals previous to his admission to the United States Marine Hospital, Baltimore.

His chief complaint was pain and inability to bear weight on the left foot and ankle. Examination of the left ankle showed the joint to be swollen and boggy, with a large ulcer on the lateral aspect and marked limitation of the astragalotibial joint. Roentgenographic examination showed fracture of the os calcis, with partial dislocation of the astragalus and roughening of the astragalocalcaneal joint, also some roughening of the articulating surface of the tibia.

After a period of observation and treatment to heal the ulcer, an operation was performed on May 12, 1937. In order to restore the astragalus to its normal position, it was necessary to free it from its attachments on all sides. Triple arthrodesis was also performed. The patient was last seen in the fall of 1938, at which time the result was good.

CASE 2. W. H., aged twenty-six, a seaman, on June 28, 1936, fell about twelve feet,



FIG. 1-A

Case 1. H. W. S. Preoperative position of tarsal bones.



FIG. 1-B

Preoperative position of astragalus.

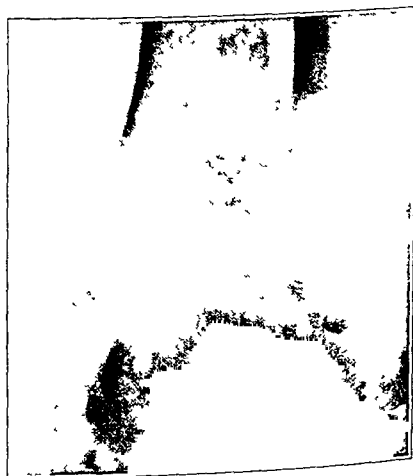


FIG. 1-C

Postoperative position of astragalus.

landing on his right foot. He was treated in another hospital until his admission to the United States Marine Hospital, Baltimore, on February 9, 1937.

He complained of swelling and stiffness of the right foot and pain when standing or walking. Examination showed swelling of the right ankle and arch, with shortening of the joint, flattening of the longitudinal arch with atrophy of the muscles of the right leg, and limitation of dorsal and plantar flexion with practically entire loss of inversion and eversion. The patient was unable to move the second, third, fourth, and fifth digits of the right foot.

On February 24, 1937, arthrodesis of the astragalonavicular and calcaneocuboid joints was performed. The patient returned to the Hospital on August 27, 1937, for a check-up examination. Roentgenograms at this time showed an exostosis on the plantar surface of the right cuboid. This was removed. Examination of the right foot showed shortening of the foot with satisfactory weight-bearing position and good union between the tarsal bones.



FIG. 1-D  
Postoperative position of tarsal bones.

#### DISCUSSION

In the first case an astragalectomy might have been performed if we had not been familiar with the report of Conwell and Alldredge, in which they called attention to Sneed's case in which he completely removed the astragalus and replaced it with an excellent result. There was no change



FIG. 2-A  
Case 2. W. H. Preoperative position of tarsal bones.



FIG. 2-B

Postoperative position of tarsal bones.

arthrodesis. A fusion of the tibio-astragalar joint was also considered, but finally it was decided that this could be done at a later date if necessary. Fortunately, the end result was good,—a painless joint and a satisfactory weight-bearing surface. This means a lot to a laborer, since Graham and Faulkner, in a review of astragalectomy cases, reported that in the cases with the best results the disability rate was 25 per cent.

The treatment in mediotarsal dislocations, as in dislocation of the astragalus, is immediate reduction. Obviously, if this had been done it would have saved these patients pain, time, and expense. When such cases are seen later, it is impossible to do a closed reduction, due to the thickened fibrous tissue. In the cases reported arthrodesis of the involved joints appeared to be the treatment of choice and gave good results.

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due to any interference with the blood supply. In the author's case, in order to obtain any satisfactory reduction, it was necessary to dissect the astragalus completely free on all sides. Due to the derangement of the astragalocalcaneal joint, it was thought advisable to do a triple

# TRAUMATIC SUBLUXATION OF THE LONG HEAD OF THE BICEPS BRACHII

## A CASE REPORT

BY HERMAN S. LIEBERMAN, M.D., NEW YORK, N. Y.

Considering the frequency of shoulder involvements seen in orthopaedic examinations, it is only rarely that a case of slipping or subluxation of the long head of the biceps tendon is diagnosed. The literature likewise records relatively few cases; the most thorough and comprehensive reports on this condition are those of Edgar L. Gilcreest <sup>1, 2, 3</sup> and A. W. Meyer <sup>4, 5, 6, 7</sup>.

The following case presented some confusion in diagnosis prior to localization of symptoms, and complete relief was obtained by operative intervention.

The patient, a colored male, aged thirty-five years, was first seen on March 10, 1936, with the complaint of pain and discoloration of the inner aspect of the right thigh, pain and swelling of the right knee, pain in the left side of the neck, upper back, and left shoulder. These conditions followed injuries sustained the previous day while the patient was shoveling coal in a hopper, which became dislodged, causing him to fall through the center, a distance of from fifteen to twenty feet. The left foot and leg extended through a chute at the bottom, while the right knee was doubled upon itself. The coal continued flowing, burying the patient completely. After several minutes he was released, and experienced pain about the right knee and thigh. He continued working for several hours, but later in the day, because of increasing pain in the left side of the neck, left shoulder, and mid-back, he was sent home. The following day, because of persisting pain and disability, he sought medical aid.

Examination of the left shoulder showed no gross changes. All motions of the shoulder were complete, but, upon abduction and external rotation, a snapping sound was audible, and an impact was palpable over the acromioclavicular area. This area was quite tender, and the patient experienced pain whenever the snap occurred, with indefinite localization about the acromioclavicular region. A tentative diagnosis of acromioclavicular subluxation was made, and roentgenograms of this site were ordered, which were reported negative. The shoulder was immobilized by means of a Velpeau bandage for two weeks, during which time the patient received infra-red irradiation and diathermy to the shoulder.

Examination following the removal of the Velpeau bandage yielded essentially the same findings as the previous examination, except that for the first time definite tenderness was present along the course of the long head of the biceps tendon, with pain at this site when the snapping was produced. New roentgenograms of the shoulder in an abducted position revealed nothing abnormal.

In view of the findings then present and the negative roentgenographic report, the possibility of a slipping of the long head of the biceps tendon was considered. This diagnosis was further substantiated by the following test:

With the arm at the side, the forearm in supination, and the elbow flexed to a right angle, the shoulder was abducted to about 90 degrees; at this position upon external rotation of the shoulder, a loud distinct snap was heard and an impact was palpable over the tendon of the long head of the biceps. When the elbow was extended to 180 degrees, with the forearm in marked pronation, and the same manoeuvre was repeated, no

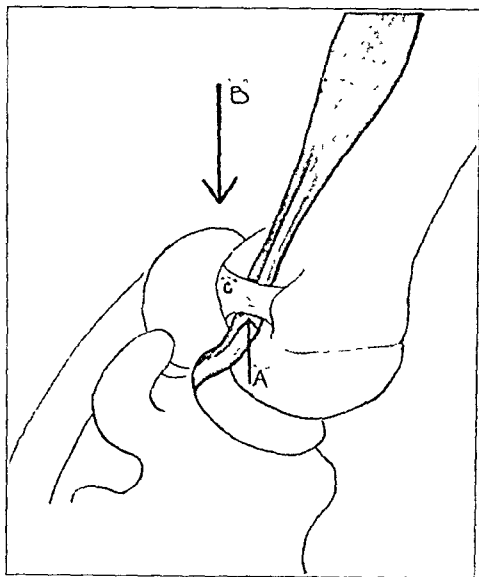


FIG. 1

Showing the direction of forces acting on the transverse humeral ligament at the time of the injury.

With the shoulder in marked abduction and external rotation, there is produced an upward force *A* against the transverse humeral ligament by the tendon of the long head of the biceps, while a downward force *B* results from the falling coal upon the shoulder. These two opposite forces, causing a shearing action upon the transverse ligament *C*, resulted in its dissolution.

capsule lying within the sulcus, but the transverse humeral ligament was not present. On external rotation of the shoulder while in abduction, a weak snapping sensation was palpable between the acromioclavicular joint and the head of the humerus, although this snapping was not audible. The capsule was then incised, and the tendon of the long head of the biceps was seen to extend normally within the joint. The clicking appeared to be due to a slipping of this tendon as it entered the intertubercular sulcus. A complete examination of the shoulder failed to reveal any other pathology. A typical Nicola operation for recurrent dislocation of the shoulder was then performed. The wound was closed in layers, and the shoulder was immobilized in a Velpeau bandage.

The patient had an uneventful postoperative convalescence. The Velpeau bandage was removed three weeks following the operation, and the wound was found to have healed by primary union. Active and passive motions were then instituted, as well as baking, massage, and sinusoidal stimulation to the muscles about the shoulder. In two months there was virtually a complete range of painless motion, and no evidence of snapping had occurred since the operation. Physiotherapy was continued for several more months, because of some shoulder stiffness which the patient noted on arising in the morning.

The patient was last seen about one year following the operation. He stated that he had returned to his former occupation of shoveling coal, and had experienced some fatigue of the shoulder only when working long hours, but at no time had the pain and snapping occurred.

snapping was produced and the patient experienced no pain. This test was repeated on numerous occasions and was always found positive.

The patient continued to receive physiotherapy, and partial immobilization was maintained for several months, without any improvement. Since no relief was obtained during this period of time, operative intervention was suggested, but was refused.

The patient was not seen again until eight months later. During this time he had attempted his former occupation of shoveling coal, but, because of the pain in the shoulder and the snapping, he was transferred to lighter work. However, the pain and disability persisted, and the patient again sought relief.

Examination of the shoulder at this time, twenty-eight months after the injury, showed essentially the same conditions as on the last discharge.

Following another series of physiotherapy, with no relief, operation was again suggested. The patient was admitted to the Hospital for Joint Diseases on November 2, 1937, and an arthrotomy was performed.

Examination of the shoulder joint showed the portion of the biceps tendon which normally extends beyond the cap-



DISCUSSION

Meyer<sup>5, 7</sup> has demonstrated on numerous occasions the evidences of use destruction in the deeper tissues of the body, as well as evidences of subluxation of the biceps tendon, due to attrition of the surrounding soft parts.

Gilcreest<sup>2, 3</sup> reported a number of cases of dislocation of the tendon of the long head of the biceps brachii, resulting from occupational strain.

In considering the causative factors of this case, we may assume that, during the patient's fall, two opposite or shearing forces acted upon the shoulder, producing the tear of the transverse humeral liga-

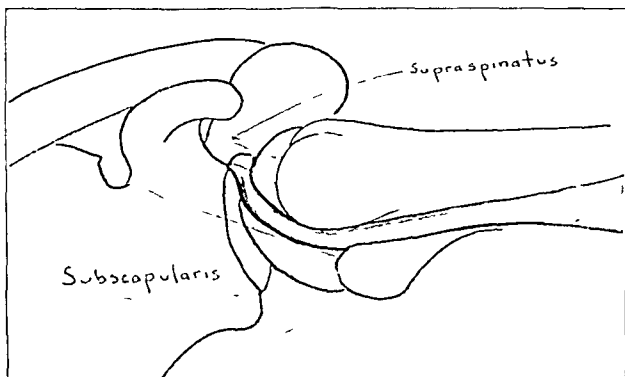


FIG. 2

The shoulder in abduction and internal rotation. The tendon of the biceps assumes an angulated course, thereby producing a mechanical resistance to its slipping. Further barriers are created by the size of the greater tuberosity as well as the directions of the muscle fibers of the supraspinatus inserted at this site. Increased tension on the biceps tendon, by maintaining the elbow in complete extension and the forearm in pronation, further serves to prevent subluxation.

ment and the subsequent subluxation. One of these forces, acting downward, was the weight of the falling coal upon the shoulder, and an opposite or upward force was produced by the tendon of the long head of the biceps against the transverse humeral ligament, while the shoulder was abducted and externally rotated (Fig. 1).

The impression obtained at the first examination of the patient and on several subsequent occasions was that the condition was due to an acromioclavicular subluxation, because of the localization of pain and the snapping sensation palpable at this site. Several roentgenograms were taken, which were negative, before this diagnosis was discarded.

The analysis of the test which was used to verify the diagnosis is as follows:

Subluxation of the tendon of the long head of the biceps brachii is most likely to occur over the lesser tuberosity, since it presents a smaller prominence than the greater tuberosity and also because of the direction of the muscles inserted into these tubercles. The supraspinatus in its attachment to the greater tuberosity presents a greater bar than does the subscapularis tendon in its insertion into the lesser tuberosity.

Subluxation is more apt to occur when the shoulder is abducted and externally rotated than when it is in the position of abduction and internal

rotation, because of the mechanical resistance offered by the tendon in its course over the humeral head prior to entering the bicipital groove, plus the prominence of the greater tuberosity and insertion of the supraspinatus (Fig. 2).

In abduction the tendon is in more or less of a straight line and is, therefore, less secure mechanically, and can easily be dislodged toward the lesser tuberosity when the shoulder is externally rotated. However, if the shoulder is abducted and externally rotated, with the elbow in complete extension and the forearm in pronation, subluxation will not occur, since the tension produced on the biceps tendon is sufficiently great to prevent its displacement.

It should be noted that at the time of operation the snapping sensation was not audible, but was weakly palpable; also that slight slipping of the tendon occurred. This at first caused considerable consternation, until it was realized that there was insufficient tension of the tendon to produce complete subluxation, because of the relaxation resulting from the anaesthetic.

#### CONCLUSIONS

The tendon of the long head of the biceps brachii is anchored within the intertubercular sulcus by the strong capsular attachments bridging the proximal portion of the sulcus and by the retinaculum farther distally. These tissues, due to repeated use, may become weakened and, under proper mechanical forces, may tear or stretch, thereby allowing the tendon to slip out of its groove.

Attrition need not, of necessity, be present, since sufficient mechanical forces acting in proper directions may also produce an acute rupture of the anchoring tissues and allow subluxation to take place.

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# LATE RUPTURE OF EXTENSOR POLLICIS LONGUS TENDON FOLLOWING COLLES' FRACTURE

BY A. T. KWEDAR, M.D., SPRINGFIELD, ILLINOIS, AND  
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Seventy cases in which a so-called "spontaneous" or late rupture of the extensor pollicis longus tendon occurred, following a fracture of the lower extremity of the radius, have been found in the literature. We are adding the following case, making a total of seventy-one cases reported.

## CASE REPORT

A female, aged forty-four, a housewife, fractured the left wrist by a fall on the left hand on December 30, 1938. Examination showed a typical "dinner-fork" deformity of the left wrist, normal sensation to pin prick, and normal movements of all fingers. Roentgenograms revealed an impacted Colles' fracture and also a fracture of the left styloid process of the ulna. On the same day, under nitrous-oxide-gas anaesthesia, the fracture was first disimpacted by increasing the deformity and then reduced by placing the hand in flexion and ulnar deviation. Fixation was by means of anterior and posterior molded plaster splints, and progress roentgenograms showed the reduction to be satisfactory.

On January 19, 1939, twenty days after the fracture, while in bed the patient felt a sharp "sting" on the dorsum of the wrist, and during the following day she noticed that she was unable to extend the thumb when reaching for an octave in playing the piano.

On February 6, 1939, upon removal of the plaster splints, examination showed that sensation to pin prick was intact over the thumb and dorsum of the hand and that faradic stimulation of the extensor pollicis longus muscle produced no extension of the thumb. Neither the distal phalanx nor the thumb could be extended voluntarily. We were unable to palpate the tendon at the dorsal boundary of the anatomical snuff-box.

On February 24, 1939, an operation was performed to repair a late rupture of the extensor pollicis longus tendon following a Colles' fracture. Under local anaesthesia (2-per-cent. novocain), a skin incision, three inches long, was made on the dorsum of the wrist. The compartment of the extensor pollicis longus tendon was opened. The distal end of the tendon was found slightly frayed and adherent to the groove medial to Lister's tubercle. A gap of two inches was present between the tendon ends. The distal end was lengthened to fill the gap and united to the proximal end with interrupted silk sutures. The patient was able to extend the thumb at the conclusion of the operation. An aluminum splint held the thumb in abduction and extension. Biopsy of the frayed tendon end showed chronic inflammatory reaction with hemorrhagic extravasation. The patient was discharged from the Hospital the next day.

On February 28, 1939, half of the skin sutures were removed, and it was found that the patient was able to extend the thumb actively. She was advised to increase active motion of the thumb slowly. On March 7, 1939, the wound was healed, but the patient was unable to extend the thumb. Reoperation was, therefore, advised.

The second operation was performed under local anaesthesia on March 20, 1939. The incision was made along the old scar. No break in the tendon was demonstrated, but it was found to be firmly bound down and inseparable from the scar tissue on the dorsum of the wrist. Excision of this scar tissue resulted in a gap of two and one-half

inches between the tendon ends. From the right leg a full-thickness graft of the peroneus longus tendon, with the tendon sheath intact, was taken and united to the two ends of the

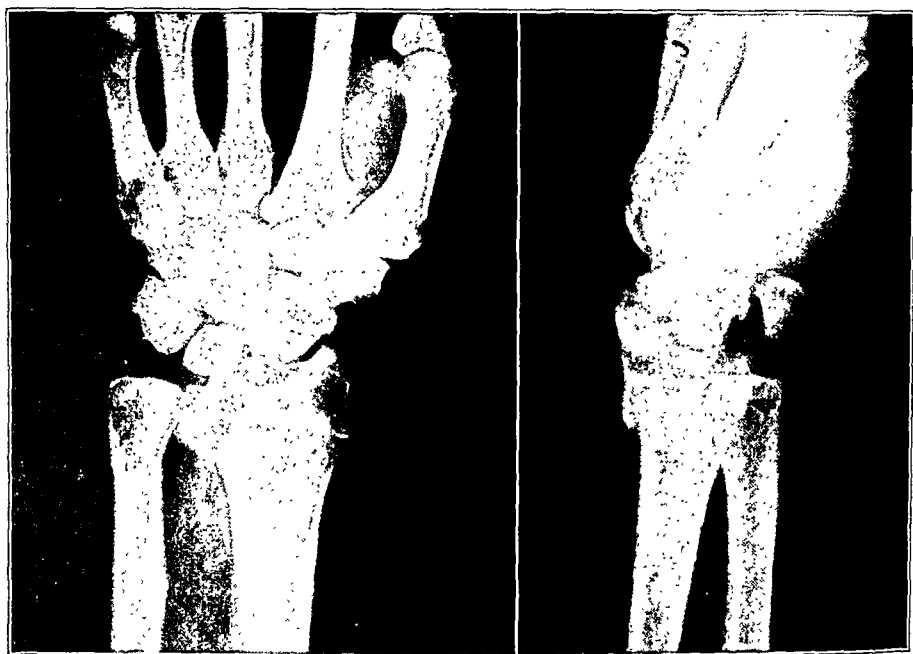


FIG. 1

Roentgenograms before reduction, taken on December 30, 1938, showing an impacted Colles' fracture of the left wrist and also a fracture of the styloid process of the ulna.

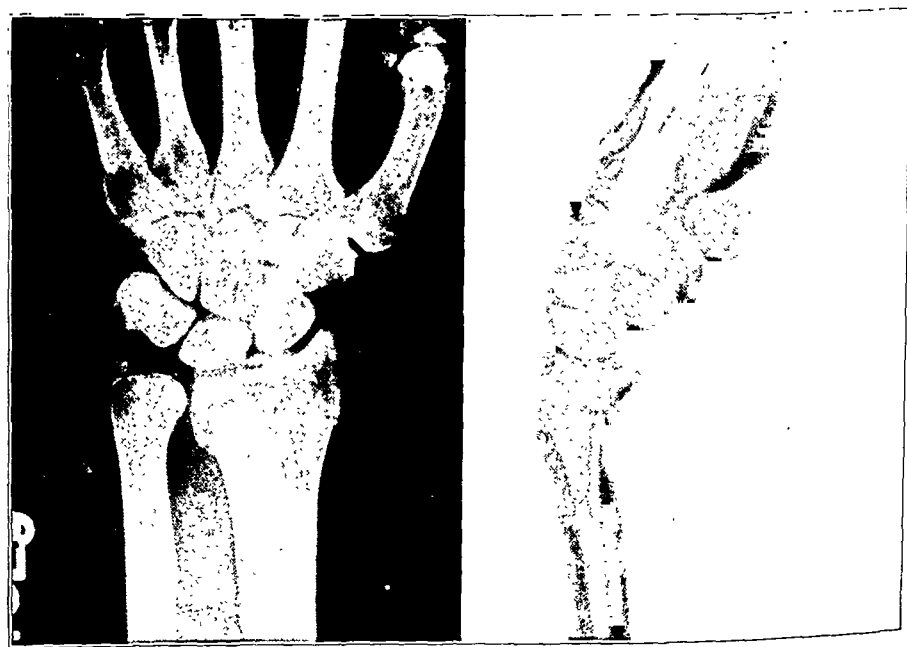


FIG. 2

Progress roentgenograms, taken on January 30, 1939, showing satisfactory reduction and healing.

extensor pollicis longus tendon by interrupted black-silk mattress sutures. The tendon sheath was stretched over the junctions, and then subcutaneous fat was sutured around both. The peroneus longus tendon was sutured to the tendon of the peroneus brevis. An aluminum splint held the thumb in abduction and extension. The patient left the Hospital on March 25, 1939.

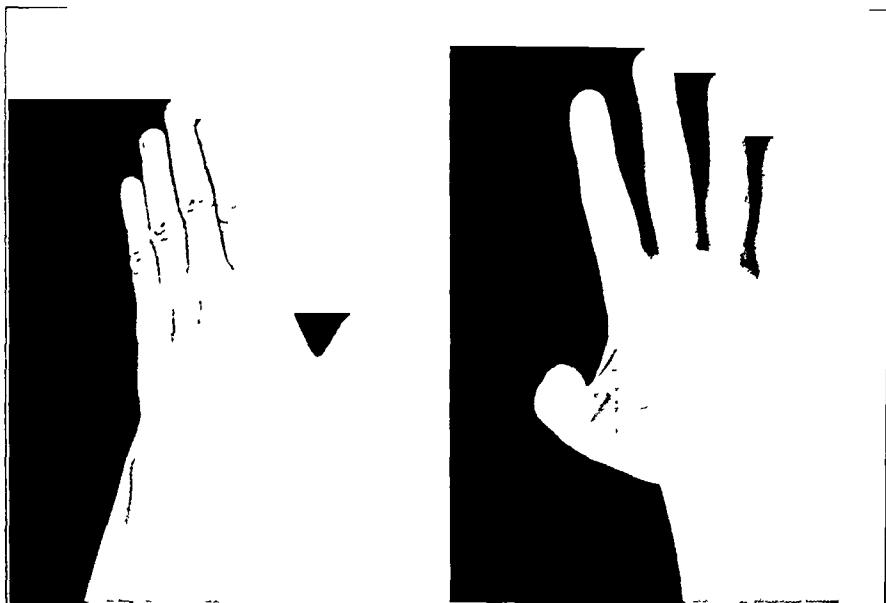


FIG. 3

Photographs of left hand, taken on February 24, 1939, showing the inability to extend the thumb before operation.

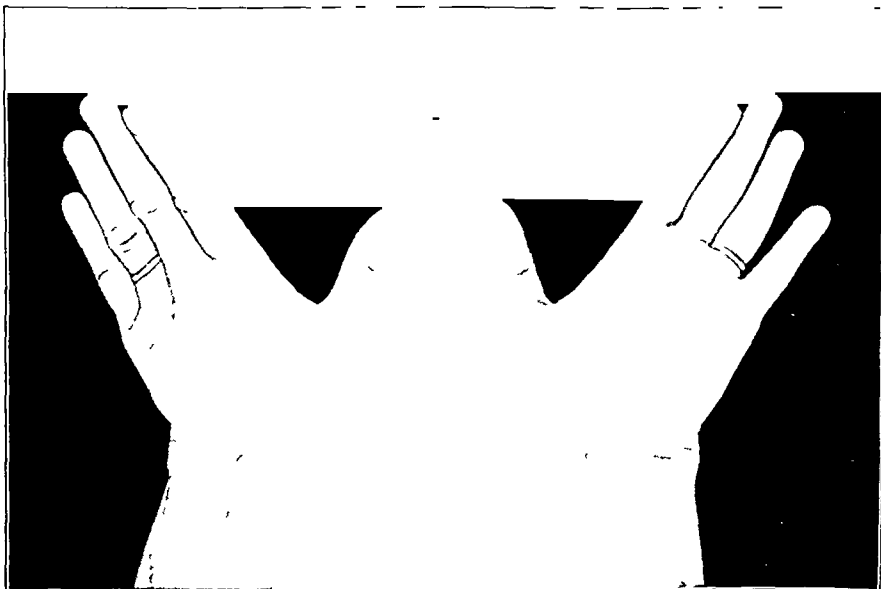


FIG. 4

Photographs of left hand, taken on May 26, 1939, showing the ability to extend the thumb nine and one-half weeks after the final operation.

The patient was able to extend the thumb satisfactorily, and the brace was gradually removed, beginning on April 21, 1939. She was seen on May 26, 1939, and progress photographs were taken. At that time the patient could obtain full extension of the thumb only when she placed the wrist in full ulnar abduction. This was due to loss of the obliquity of the tendon on the dorsum of the wrist.

#### ETIOLOGY AND PATHOLOGY

Sufficient information was present in fifty of the seventy cases found in the literature to permit the compilation of statistical data. It was found that of the fifty patients twenty (40 per cent.) were males and thirty (60 per cent.) were females. Just why the rupture occurs more frequently in the female than in the male is difficult to explain. Lipshutz has stated that the greater incidence of injury to this tendon in women may have its basis in a more frail structure of the vessel walls; and, furthermore, that the female skeleton in general is characterized by the smaller development of processes and ridges for muscular and ligamentous attachments, offering less protection to the tendon and its blood supply.

An analysis of the fifty cases shows that the greatest incidence of tendon ruptures is found between the ages of twenty-one and forty years. This may be due to the fact that the blood supply to the tendon decreases after the age of twenty-five (Weigeldt) and also because of the increased frequency with which Colles' fractures occur during the most active years of life.

One would expect to find late ruptures of the tendon more often than the reports would indicate, because of the great number of Colles' fractures and the intimate relationship between the extensor pollicis longus and the end of the radius. However, the studies of various authors (Pörsch, Oppolzer, and Horwitz) have revealed that the condition occurs approximately once in 270 cases.

The average latent period between the time of the fracture and the occurrence of the tendon rupture is six weeks. The longest time interval was ten years in a case reported by Coenen. The shortest interval was one week in a case described by Lapeyre; and Strøm has reported the only case in the literature in which an incomplete tendon rupture occurred immediately after the fracture.

Trauma at the time of the Colles' fracture is the predisposing cause of the rupture. The tendon may be partially severed by a bone fragment, but, most likely, the blood supply of the tendon is interfered with by direct injury to the vessels, by pressure from hemorrhage, or, later, by scar-tissue formation. Explanation of the mechanism of rupture on a vascular basis is given support by the fact that in from 5 to 8 per cent. of all cadavera there is a hypogenesis of the blood vessels to this tendon (Lipshutz). This consists of smaller-calibered blood vessels and a decrease in the number of their branches.

The exciting cause of the so-called "spontaneous" rupture is a sudden flexion or extension of the thumb. The rupture has occurred while play-

ing the piano, throwing a ball, washing dishes, swimming, turning a key, placing the hand in a pocket for an object, or putting on a glove.

At operation the tendon is found to be frayed and at times attached to the periosteum by fibrous strands. Sometimes only one of the two ends is attached. In our case the proximal end was attached. The presence of hydrops or "jelly-like" matter was reported by Horwitz, who believed a nutritional change had taken place in the tendon. Simon, in 1931, was the first to report the presence of necrosis accompanied by aseptic pus. Biopsy in our case revealed chronic inflammatory changes in the frayed tendon end with evidence of old hemorrhage.

#### SYMPTOMS AND DIAGNOSIS

Although in the majority of cases the patients have no pain prior to the rupture following a Colles' fracture, there are some patients who complain of pain over the dorsum of the wrist for as long as ten days preceding the tendon rupture. Following a trivial violence about six weeks after the fracture, the patient suddenly experiences a sharp pain or "snap" on the dorsum of the wrist and thereafter is unable to extend the thumb.

Examination reveals that the patient is unable to extend the distal phalanx of the thumb; also that the tendon of the extensor pollicis longus cannot be felt on the dorsal boundary of the anatomical snuff-box. There are no sensory disturbances of the thumb or hand, and faradic stimulation of the extensor pollicis longus muscle does not extend the thumb. Drooping of the terminal phalanx may be inconspicuous in the cases where the distal tendon end has acquired a stout adhesion to the lower end of the radial groove (Platt).

Kleinschmidt states that clinically a friction rub can be heard when the extensor pollicis longus tendon is moved after a fresh fracture, and this is due to a tear in the tendon sheath. If this were heard after loss of extension of the thumb, it would be due to the rubbing of the frayed proximal end of the tendon in the radial groove and would be pathognomonic of late rupture of the tendon. DePlanque reported a case of late rupture of the extensor pollicis longus tendon, not complicated by a fracture of the radius, in which he could feel crepitation along the radial groove when the patient contracted the extensor pollicis longus muscle.

#### PROGNOSIS AND TREATMENT

The prognosis is good in operative cases. In almost every reported case in which the tendon was repaired a satisfactory result was obtained. Without surgery, recovery of useful function of the thumb is not to be hoped for.

The ideal treatment is an end-to-end union of the two severed stumps. If the proximal end of the tendon has retracted under the dorsal carpal ligament, it is necessary to open the tendon compartment just medial to Lister's tubercle. The tendon is not replaced in its groove, for closure of the compartment is then not practicable. Platt, however, attempts to

preserve the oblique course of the tendon by passing it through a fascial pulley, thus holding the tendon near its original compartment on the dorsum of the radius. If this is not done, loss of the angulation of the tendon at any time after the operation would be synonymous with a lengthening of the tendon, and the power of full extension of the distal phalanx would be lost. We attempted to accomplish this by suturing the subcutaneous fat about the tendon to preserve its obliquity, but this was unsuccessful, for our end result shows that the patient must place the hand in full ulnar abduction in order to obtain complete extension of the thumb. She can, however, extend the distal phalanx with the hand in a neutral position.

When the proximal end of the tendon has not been found, the distal end has been attached to the abductor pollicis longus, to the extensor pollicis brevis, to the extensor indicis proprius, or to the extensor carpi radialis longus. Even though this requires reeducation of the muscles, satisfactory results have been obtained.

When a gap exists between the tendon ends, lengthening of the tendon or the insertion of a graft is required to unite the two ends. In our case we first lengthened the distal tendon end to fill a deficiency of two inches. This was done first by tying off the distal stump and then by splitting the tendon distal to the tied portion and cutting and unfolding half of the split tendon. This gave a very satisfactory immediate result, but we did not cover the tendon with fat or fascia, and, within about ten days, adhesions formed between the tendon and the dorsum of the wrist, so that the operation was futile. At the second operation we used a free graft from the peroneus longus tendon.

Von Stapelmohr used the abductor pollicis longus tendon as a free transplant to close a five-centimeter defect. He formed a new tendon sheath from fascia lata. For a free tendon graft Platt used the extensor digitorum longus of the foot; Boyes, the palmaris longus. Pollosson, in 1932, reported an unusual case in which a tendon graft from a person who had just died had been successfully used.

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# IRREDUCIBLE BUTTONHOLE DISLOCATIONS OF THE FINGERS

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*Adjunct Orthopaedist, Mount Sinai and Bellevue Hospitals*

Dislocations of the phalanges of the fingers are exceedingly common and can usually be reduced by simple traction applied through the terminal phalanx. This manoeuvre is usually performed without anaesthesia and is often carried out by the amateur bone-setters who are to be found on most baseball or football fields. Similar treatment is carried out in hospital accident wards, and the results are usually so satisfactory that no post-reduction roentgenograms are taken. The finger is merely immobilized on an anterior tongue-depressor splint, and the patient is advised to return in a week or ten days. Clinically, it is occasionally difficult to determine whether the reduction has been complete. Even though the bones are directly subcutaneous, the oedema and accompanying tenderness mask the true state of affairs unless the examination is very careful and painstaking. Occasionally the simple manoeuvre described above fails to reduce the dislocation, and, unless the condition is promptly recognized and corrected, there will be almost complete loss of motion at the involved joint.

CASE 1. J. B., male, aged forty-two, injured the left ring finger by striking it against an object. A palmar dislocation of the middle phalanx was recognized in the emergency ward of one of the City's largest institutions, and reduction was attempted by traction. The finger was immobilized on an anterior splint with a small pressure pad of felt over the dorsal aspect of the distal interphalangeal joint. Ten days later the finger was seen by one of the authors, who thought that the amount of thickening and irregularity of the bone contours suggested an unreduced dislocation. Roentgenographic



FIG. 1

Case 1. Unreduced dislocation at the distal interphalangeal joint ten days after attempted reduction.

examination (Fig. 1) revealed that the dislocation had not been reduced. The patient was referred back to the hospital where the original dislocation had been treated, and there four closed attempts to reduce the dislocation under local and general anaesthesia were made without success.

Operation was then performed under gas-oxygen anaesthesia, twelve days after the injury. A longitudinal incision was made over the dorso-

lateral aspect of the joint, and the capsule was found as a redundant fold between the bones. This was severed longitudinally, and reduction was obtained at once. The capsule was reefed by sutures, maintaining the reduction, and the finger was splinted in flexion (Fig. 2).



FIG. 2

Case 1. Reduction after open operation.

When this patient was examined eighteen months after the operation, there was distinct thickening of the interphalangeal joint, and a bony swelling could be palpated on the dorsal aspect of the middle phalanx. There was less than 5 degrees of active motion at the distal interphalangeal joint, but passively there was about 25 degrees of motion from a straight line. This is about 40 per cent. of the normal range of motion that exists at this joint. Roentgenographic examination revealed osteo-arthritis of the distal interphalangeal joint and the area of subperiosteal calcification on the dorsal aspect of the middle phalanx that had been noted on clinical examination.

While the result in this case is moderately satisfactory, too long a time was permitted to elapse between the dislocation and the operative reduction. Also too many traumatizing attempts at closed reduction had been made. If one careful and painstaking attempt at closed reduction is unsuccessful, open operation should be resorted to without further traumatizing efforts.

If the dislocation is not recognized until three or more weeks have elapsed, the prognosis for a movable joint is not good, even if the surgeon is successful in reducing the dislocation by open operation. The amount of fibrosis and scarring necessitates such extensive dissection to free the bone ends that fibrous or bony ankylosis will usually occur. It is true that the bony protuberance, due to the dislocation, will be removed and the pain will be less, but too much motion should not be expected. This is well demonstrated in the following case.

CASE 2. J. Mc., male, aged twenty-seven, suffered a palmar dislocation of the proximal phalanx of the right ring finger. An attempt at closed reduction was made, and the finger was immobilized on an anterior tongue-depressor splint for two weeks. Six weeks had elapsed before the patient was

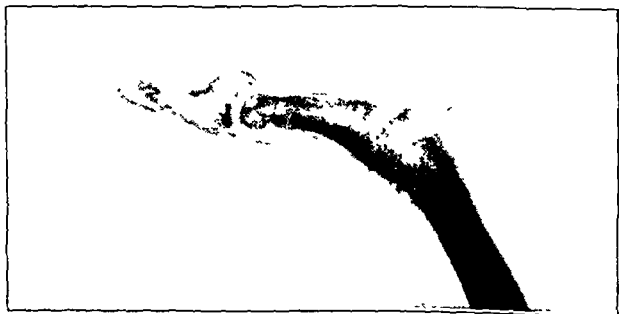


FIG. 3

Case 2. Bony ankylosis following extensive dissection to reduce a six-weeks-old dislocation.

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FIG. 3

Case 2. Bony ankylosis following extensive dissection to reduce a six-weeks-old dislocation.

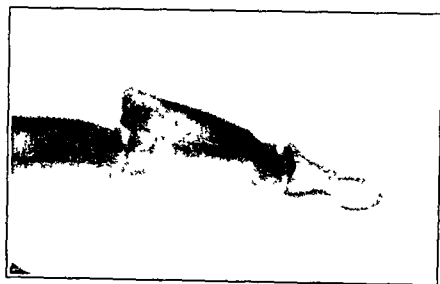


FIG. 4

Case 3. Dislocation before attempted closed reduction.

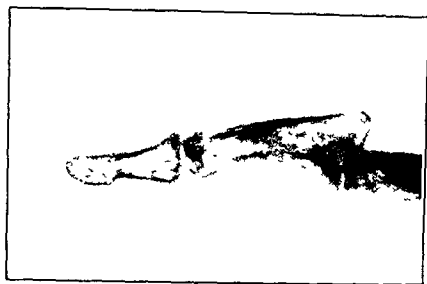


FIG. 5

Case 3. Roentgenogram taken after two weeks of splinting, showing the dislocation still present.

seen by one of the authors, who recognized the unreduced dislocation. Open operation was performed, and, after much dissection of scar tissue, the dislocation was reduced and held by an anterior splint in the flexed position. At the end of two weeks the splint was removed for active and passive motion, and was reapplied. In spite of careful physiotherapy, carried out by the surgeon, bony ankylosis occurred (Fig. 3).

It is well to explain the situation to the patient whose dislocation is recognized three or four weeks after the injury. Operation is advisable for cosmetic reasons and to avoid the pain of a projecting bony prominence. Also a certain amount of motion may be obtained. However, the likelihood of a stiff joint should be carefully explained to the patient.

CASE 3. E. G., male, aged thirty-nine, suffered a fracture-dislocation at the proximal interphalangeal joint of the right ring finger. The usual anterior displacement of the proximal phalanx had occurred (Fig. 4). An attempt at reduction was made by his physician, and an anterior splint was applied. No check-up roentgenogram was taken. Roentgenographic examination (Fig. 5) two weeks later revealed that the dislocation was still present. When the prognosis following operation was explained to the patient, he refused surgery and at present has a stiff, painful joint.

If the condition is promptly recognized and corrected by operation after one closed attempt has been unsuccessful, the results are usually excellent.

CASE 4. E. S., male, aged twenty-four, suffered a compound dislocation at the distal interphalangeal joint of the right ring finger while playing baseball. The usual palmar displacement of the middle phalanx was present. An attempt at closed reduction under block anaesthesia was unsuccessfully made. Through the dorsolateral wound, which was carefully débrided, the opening in the dorsal extensor apparatus was widened, and through this the buttonhole in the anterior capsule was split with scissors, and the dislocation was easily reduced by traction. The finger was immobilized in an anterior splint. This patient refused to return to the follow-up clinic, but sent a note stating that he had normal motion and no pain and did not have time to come to the clinic.

In children and adolescents the situation is further complicated by the epiphysis which exists at the proximal end of each phalanx. If dislocation occurs, the epiphysis may remain with the proximal phalanx, while the diaphysis of the distal phalanx is dorsally displaced.

CASE 5. H. K., female, aged nine, caught the left little finger in a clothes hanger and suffered a compound dislocation at the distal interphalangeal joint. The epiphysis of the distal phalanx remained with the middle phalanx, which was displaced anteriorly

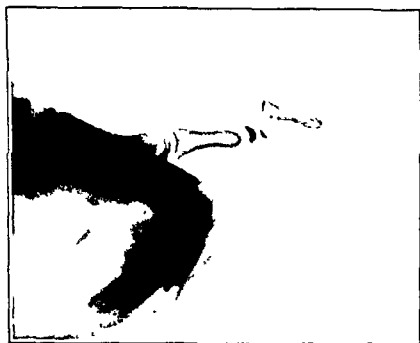


FIG. 6

Case 5. The separation in this dislocation occurred at the epiphyseal line.



FIG. 7

Case 5. The epiphyseal line is still open at the fracture site.

(Fig. 6). The family physician removed the the fingernail under ether anaesthesia, noted the protruding end of the diaphysis of the distal phalanx, and referred the patient to one of us.

Under ether anaesthesia the wound was débrided, and an unsuccessful attempt made to reduce the dislocation by traction. It was necessary to open the buttonhole tear in the anterior expansion of the capsule through which the middle phalanx was protruding before reduction could be obtained. The finger was immobilized on an anterior curved splint for three weeks.

The patient made an uneventful recovery, and, within two months of the injury, normal motion was present in the involved joint. A recent roentgenogram (Fig. 7), twenty months after the injury, reveals that some growth has occurred at the once displaced epiphysis. Clinically, there is no limitation of motion, and the patient has had no pain.

On the other hand, the epiphysis may remain with the distal fragment, as in the following case (Fig. 8).

CASE 6 \*. B. N., male, aged twelve. This dislocation was reduced by open operation ten days after the accident. Six weeks after operation the range of motion was about 50 per cent. of normal and was increasing daily.

The anatomy of the region <sup>5</sup> accounts for the difficulty that is occasionally encountered in reducing the palmar dislocation of the middle or proximal phalanges. The distal end of the more proximal phalanx is forced through a buttonhole tear in the glenoid ligament, which is really a thickened portion of the anterior capsule of the joint. The buttonhole tightly hugs the narrow portion of the phalanx immediately behind the head and prevents closed reduction. Occasionally a fold of the dorsal extensor aponeurosis also becomes caught between the bone ends and prevents reduction. In one case the flexor digitorum profundus tendon

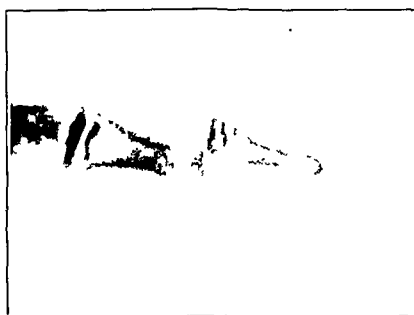


FIG. 8

Case 6. The epiphysis remained in place during the dislocation.

\* Case presented through the courtesy of Dr. J. C. McCauley.

had somehow become caught between the dislocated bones and prevented successful closed reduction of the displacement. If the dorsal aponeurotic fold is not removed from between the bone ends, the dislocation can be almost, but not completely, reduced and will recur as soon as the powerful traction of the reducing force is removed.

Cases of irreducible phalangeal dislocations have been described by several French and British observers. <sup>1, 2, 6, 7, 8</sup> The most complete description of the subject was written by Farabeuf<sup>3</sup>, the celebrated French surgeon, who recognized and described in detail the anatomy and operative treatment of dislocations at the metacarpophalangeal joint of the thumb. He observed clinically and in dissections on 100 cadavera that the metacarpal head is forced through a buttonhole tear in the glenoid ligament (anterior portion of the capsule) and between the two heads of the flexor pollicis brevis muscle. He classified the dislocations as complete and incomplete. In incomplete dislocations the glenoid ligament is still in contact with the posterior part of the articular head, which has not entirely passed through the rent in the anterior portion of the capsule. Farabeuf described a method of closed manipulation to reduce the dislocation: The metacarpal bone is flexed into the palm of the hand to relax the short flexor, and the first phalanx is then markedly hyperextended and pushed forward and distally. In complete dislocations he suggested dividing the inverted glenoid ligament vertically against the metacarpal, on the dorsal aspect.

The same basic pathology exists at the interphalangeal joints as at the metacarpophalangeal joint of the thumb. The distal end of the proximal phalanx entering into the dislocation is forced through a rent in the glenoid ligament and held until relieved by manipulation or by open operation.

In all dislocations of the phalanges a careful and painstaking examination should be made after reduction, and, if any doubt exists as to the completeness of the reduction, a roentgenogram should be taken. If the roentgenogram reveals that the dislocation has not been completely reduced, a closed attempt should be made under anaesthesia, and, if unsuccessful, the dislocation should be exposed by open operation and reduced. If one suspects that the circulation of the fingertip is compromised, especially in compound dislocations, it is wiser to use general rather than local-block anaesthesia to avoid even the remote danger of gangrene.<sup>4</sup> A dorsolateral incision or a dorsal skin flap with the base proximal may be used. The buttonhole opening in the glenoid ligament should be enlarged vertically, and the dislocation should be reduced by traction and maintained on an anterior curved splint. If the dislocation is compound, the wound should be thoroughly débrided, and an attempt should be made to reduce the dislocation by traction. If this is unsuccessful, the glenoid ligament can be attacked through the wound that already exists. Because of the poor results that follow delay, it is unwise to wait for healing of a compound dislocation before proceeding with



operative reduction. One should carefully débride the wound and run the risk of infection that may follow immediate operative reduction.

Injuries of the fingers are important, and a bad result may be disabling out of all proportion to the size of the part involved. The treatment of these injuries should not be turned over without supervision to an inexperienced junior house officer. It is not beneath the dignity of an attending surgeon to treat dislocations and fractures of the fingers. He will find that he requires all his ingenuity and skill in dealing with these small lesions. The phalanges possess to a high degree that irritating quality of inanimate objects,—an apparently inspired passive resistance to our best efforts.

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# OSTEOCHONDRITIS DISSECANS OF A METATARSAL HEAD

BY BRANDON CARRELL, M.D., DALLAS, TEXAS, AND HAROLD M. CHILDRESS, M.D., JAMESTOWN, NEW YORK

Osteochondritis dissecans of a metatarsal head is a rare condition. The following case, however, is reported primarily because it illustrates the importance of roentgenographic study in making a diagnosis of a loose body within a joint.

M. L. G. (No. 13318), white female, aged thirty-eight, was seen at the Carrell-Girard Clinic in Dallas on March 14, 1939. Seven months previously pain had developed in an area inferior to the left first metatarsophalangeal joint. The patient gave no history of trauma, but at that time her duties as a saleslady had required considerable walking. She had been treated by a chiropodist, who strapped the metatarsal arches with adhesive tape, but the localized pain persisted. Roentgenograms revealed a small object at the medial side of the joint, which the family physician thought to be a broken-off portion of a steel needle. An effort to remove the body under local anaesthesia was not successful. The patient stated that for the past six months the pain had been present upon extensive walking, and that she was certain that there was some movable object within the joint.

Examination of the left foot was negative except for a small, healed, operative scar at the medial base of the left great toe. A roentgenogram (Fig. 1), brought in by the patient, showed a distinct body in the medial part of the joint, which resembled a portion of a needle. Routine anteroposterior and lateral roentgenograms were ordered to learn the exact position of the object, and the patient was advised to have the body (supposedly foreign in nature) removed.

A study of the lateral roentgenogram (Fig. 2) brought out the fact that the object within the joint had practically the same density as the adjacent bone. A closer survey



FIG. 1

Showing an apparent rod-shaped body in the joint.



FIG. 2

The object appears to be osseous in nature.

of the anteroposterior view also showed the body to have this same density, although at first glance it appeared to be of a markedly increased density. It was concluded that the object was not a portion of a needle, but a disc-shaped or a square piece of bone. In addition, there was evidence of moderate arthritic changes in the joint, which could have been caused by repeated minimal traumata. A tentative diagnosis of osteochondritis dissecans, with the probable release of the fragment from the metatarsal head, was made.

Upon surgical exposure of the joint, a circumscribed, depressed area, about eight-tenths of a centimeter in diameter and two-tenths of a centimeter in depth, was seen in the anterior portion of the metatarsal head (Fig. 3). Upon curetting out a few flakes of softened cartilage, one could see cancellous bone at the base of the crater. There was one loose, disc-shaped, osteocartilaginous body lying in the medial side of the joint. Its size corresponded closely to the dimensions of the crater.

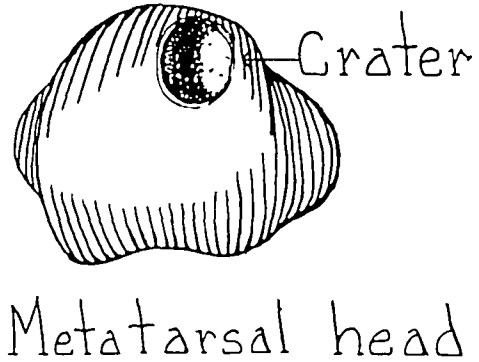


FIG. 3

Drawing showing crater in metatarsal head.

The pathological report stated that section through the decalcified specimen showed a thin outer zone of dense fibrohyaline tissue. In one or two areas focal ossification was demonstrable.

The final diagnosis was osteochondritis dissecans of the first left metatarsal head.

Multiple roentgenograms, clear in detail and taken from various angles, are essential in making an accurate study of a loose body in a joint. As noted in this case, such films establish not only the exact position of the object, but also its relative shape, size, and structure.

# OSTEOCHONDRITIS DISSECANS OF A METATARSAL HEAD

BY BRANDON CARRELL, M.D., DALLAS, TEXAS, AND HAROLD M. CHILDRESS, M.D., JAMESTOWN, NEW YORK

Osteochondritis dissecans of a metatarsal head is a rare condition. The following case, however, is reported primarily because it illustrates the importance of roentgenographic study in making a diagnosis of a loose body within a joint.

M. L. G. (No. 13318), white female, aged thirty-eight, was seen at the Carrell-Girard Clinic in Dallas on March 14, 1939. Seven months previously pain had developed in an area inferior to the left first metatarsophalangeal joint. The patient gave no history of trauma, but at that time her duties as a saleslady had required considerable walking. She had been treated by a chiropodist, who strapped the metatarsal arches with adhesive tape, but the localized pain persisted. Roentgenograms revealed a small object at the medial side of the joint, which the family physician thought to be a broken-off portion of a steel needle. An effort to remove the body under local anaesthesia was not successful. The patient stated that for the past six months the pain had been present upon extensive walking, and that she was certain that there was some movable object within the joint.

Examination of the left foot was negative except for a small, healed, operative scar at the medial base of the left great toe. A roentgenogram (Fig. 1), brought in by the patient, showed a distinct body in the medial part of the joint, which resembled a portion of a needle. Routine anteroposterior and lateral roentgenograms were ordered to learn the exact position of the object, and the patient was advised to have the body (supposedly foreign in nature) removed.

A study of the lateral roentgenogram (Fig. 2) brought out the fact that the object within the joint had practically the same density as the adjacent bone. A closer survey



FIG. 1

Showing an apparent rod-shaped body in the joint.



FIG. 2

The object appears to be osseous in nature.

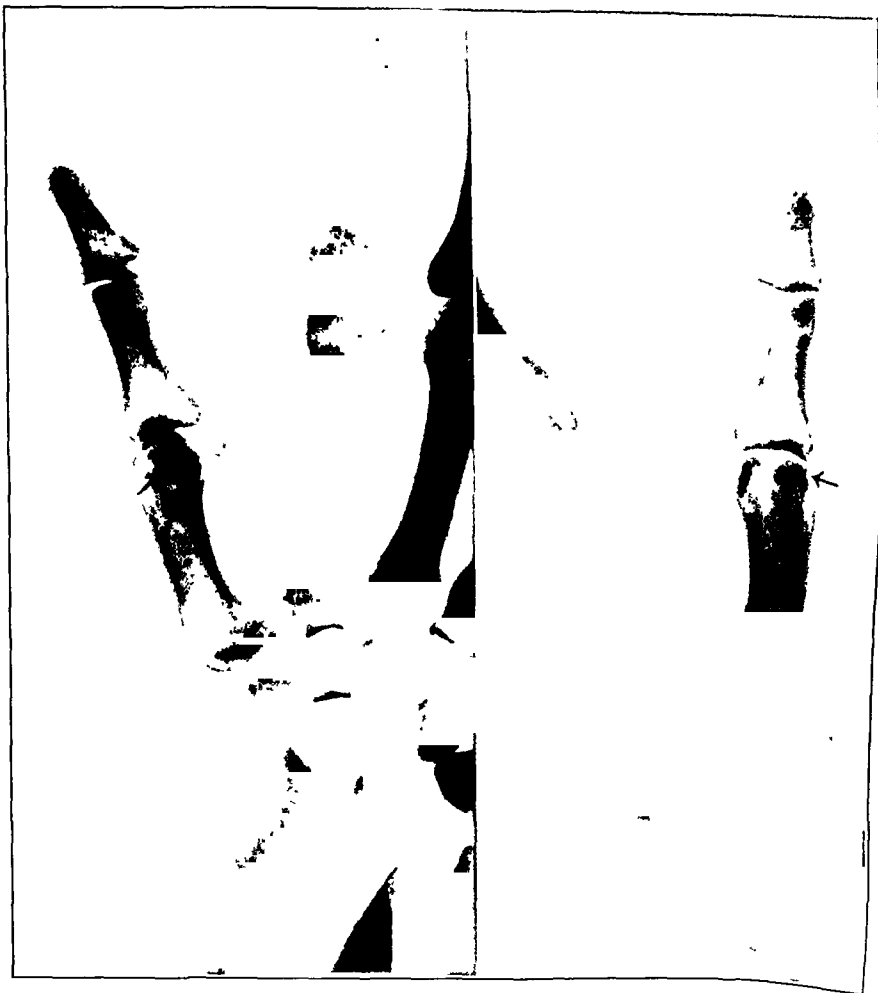


FIG. 2

Twenty-five months after the original trauma. Bony union is present.

in the roentgenogram of the opposite side, and, finally, microscopic evidence of fracture, if an operation has been done. Roentgenographically, the edges of the fragments of a bipartite sesamoid are smooth and regular. The opposite side usually shows a similar bipartite sesamoid.

So far as treatment is concerned, the case presented in this report and the case of Streatfeild and Griffiths<sup>4</sup> show that immobilization of the affected digit will result in healing with good functional result.

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4. STREATFEILD, THOMAS, AND GRIFFITHS, H. F.: Fracture of a Sesamoid Bone. *J. Bone and Joint Surg.*, I, 1117, 1934.

# COMMINUTED FRACTURE OF CLAVICLE WITH PRESSURE ON BRACHIAL PLEXUS

## REPORT OF A CASE

BY HALL G. VAN VLACK, M.D., JAMESTOWN, NEW YORK

Comminuted fractures of the clavicle in adolescents and in adults are not rare. The loose fragments in most cases are a potential danger to the important structures lying immediately subjacent. Without the aid of roentgenograms many physicians attempt to reduce such fractures. Roentgenograms are then taken to determine the results of the manipulation. The following case is reported to emphasize the fact that comminuted fractures of the clavicle should not be manipulated or have final splinting until the exact position of the fragments is learned by adequate roentgenographic study.

### CASE REPORT

An Italian boy, aged sixteen, sustained an injury to the right-shoulder area when he tackled another player in a football game. He was seen soon afterward by his physician. A diagnosis of comminuted fracture of the clavicle was made, and roentgenographic examination was advised. Due to financial reasons, the father requested that roentgenograms not be taken. The physician attempted to reduce the fracture, but became alarmed when the patient complained of sharp pain coursing down the medial portions of the right arm and forearm. This pain recurred upon any effort to bring the right shoulder into a corrected up-and-out position and upon pressure on the extended superior point of the proximal clavicular fragment. A roentgenogram (Fig. 1) was taken, which revealed a comminuted fracture of the lateral portion of the middle third of the right clavicle with upward displacement of the proximal fragment. There was a ragged-



Fig. 1

Roentgenogram showing loose clavicular fragment turned crosswise to major fragment.

edged fragment, about two and five-tenths centimeters in length and one centimeter in width, which was separated from the major fragments. It was rotated nearly 90 degrees, and its axis was superior-inferior. Upon examination the sharp tip of the loose fragment was palpable immediately beneath the skin. There was a hypaesthesia to cotton touch and to pin prick over the distributions of the medial cutaneous nerves to arm and forearm. No motor disturbances were found. The circulation to the right arm was not impaired, and there were no signs of deep hemorrhage at the fracture site. The pleura on the right was apparently uninjured. It was believed that the loose fragment, turned crosswise to the major clavicular parts, was in contact with the medial cord of the brachial plexus.

An open reduction was done at once, and the fragment was found to have torn through the periosteum and the subclavius muscle and to have penetrated into the soft structures directly inferior. It was cautiously removed and was fitted into its original position and held by two vitallium screws. Recovery was uneventful, and the patient has had no further complaints of nerve pressure.

The strong posterior periosteum and the subclavius muscle in most cases protect the underlying structures from sharp edges of clavicular-fracture fragments. Immediate complications may consist of trauma to the brachial plexus, laceration of the subclavian artery or subclavian and internal jugular veins, and puncture of the pleura with or without damage to the apex of the lung. Late complications are due to pressure on vessels and nerves caused by shifting fragments or by excess callus formation. Also, aneurysms may develop in regional blood vessels. As demonstrated in this case, any manipulation of comminuted clavicular fractures without adequate roentgenographic study is extremely hazardous.

# CONTROL OF FRAGMENTS AFTER OSTEOTOMY FOR CONGENITAL DISLOCATION OF HIP

## A SIMPLE GUIDE FOR CONTROL OF ANTERIOR ANGULATION

BY HAROLD UNGER, M.D., AND THOMAS L. WARING, M.D., IOWA CITY, IOWA

*From the Department of Orthopaedic Surgery,\* State University of Iowa, Iowa City*

In the operative treatment of congenital dislocation of the hip by osteotomy, it is necessary to produce at the site of the osteotomy not only a medial but also an anterior angulation. The medial angulation affords stability to the pelvis. The anterior angulation also adds to the stability, but its greatest value lies in overcoming the lumbar lordosis, thereby bringing the longitudinal axis of the lower extremities to the same frontal plane as the longitudinal axis of the body.

The medial angulation is produced by abduction of the distal fragment, while the anterior angulation is produced by hyperextension of the distal fragment. The same angular effects can also be produced by adduction and flexion of the proximal fragment immediately after osteotomy; but, since the short proximal fragment is much less controllable than the long distal fragment, the former procedure is the one of choice.

Before such an osteotomy can be considered, it is very essential that the involved hip have adequate adduction and flexion ranges. Otherwise, the patient would be unable to bring the abducted and hyperextended distal fragment to the neutral position, which is necessary for walking.

Control of the fragments following osteotomy is very important. This control is accomplished for the medial angulation by two Schanz screws with or without a Riedel plate, as frequently described in the literature by Schanz, Gaenslen, and Riedel. (See Figures 1-A, 1-B, and 1-C.)

For the control of anterior angulation we have employed a rather simple device:

Two rectangular winged flanges, about one and one-eighth inches by one-fourth of an inch, with adjustable setscrews are attached to the ends of the two Schanz pins,—that is, one flange to each pin. Before the osteotomy, these flanges are adjusted, so that they lie parallel and in a straight line when viewed from the side. When the distal fragment is hyperextended after the osteotomy, there appears an anterior angulation between the two flanges. This angle can be easily estimated or accurately measured if necessary. The desired position following the osteotomy is thereby easily maintained during the application of the cast. (See Figures 2-A, 2-B, and 2-C.)

This simple device for the control of the anterior angulation has been used successfully by the authors.

\*Service of A. Steindler, M.D.



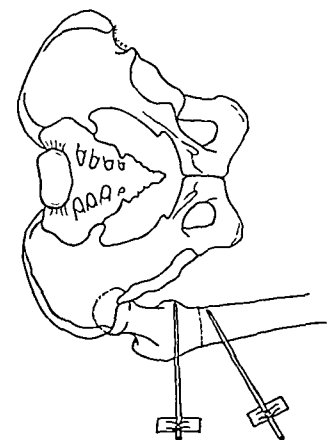


Fig. 1-A  
Position of pins before osteotomy.

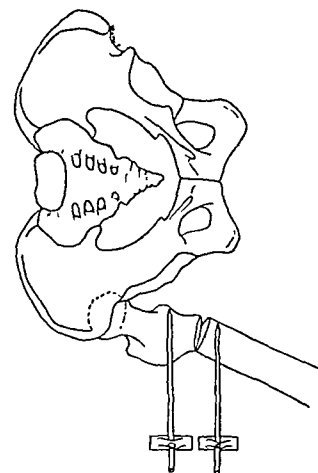


Fig. 1-B  
Distal fragment abducted after osteotomy.

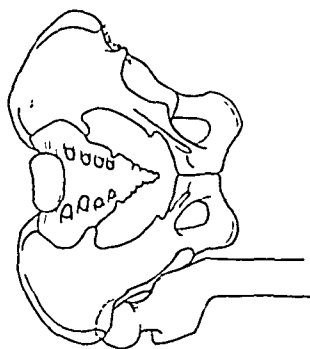


Fig. 1-C  
Limb adducted to vertical or neutral position after union at site of osteotomy.

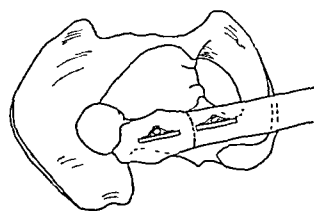


Fig. 2-A  
Position of flanges before osteotomy.

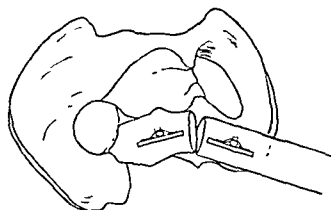


Fig. 2-B  
Distal fragment hyperextended after osteotomy.

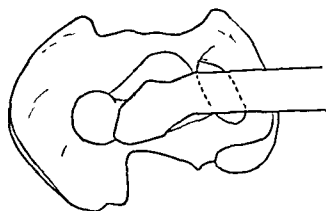


Fig. 2-C  
Limb flexed to vertical or neutral position after union at site of osteotomy.

# A DEVICE TO FACILITATE ACCURATE INSERTION OF THE SMITH-PETERSEN NAIL

BY DUNCAN C. MCKEEVER, M.D., HOUSTON, TEXAS

It is with considerable hesitancy that one presents a new guide for the insertion of the Smith-Petersen nail. There are several satisfactory types of guides available, which, in the hands of those accustomed to their use, produce excellent results.

Experience with the nailing of over sixty fractured hips by the method of Dr. Lawson Thornton, without the use of any mechanical guide, revealed the following: The average operating time from incision to closure was slightly over thirty minutes. In no case was it over one hour, and in none, under twenty minutes. However, in about one case in each five, it was necessary to withdraw and to redirect the nail one or more times to obtain satisfactory position. This definitely lengthened the operative procedure, because of the time required to secure the roentgenograms. There can be no question that the saving of even a few minutes is of great importance in the case of a senile individual.

There are a great many devices for accurately placing a pin or wire over which the cannulated Smith-Petersen nail may be inserted. The simplest of these is the Bailey guide. It seemed reasonable that, if a wire could be accurately inserted, the nail itself might also be so introduced; and that, if this were possible, a definite saving in operating time might ensue. There should be no difficulty in placing the nail in the proper

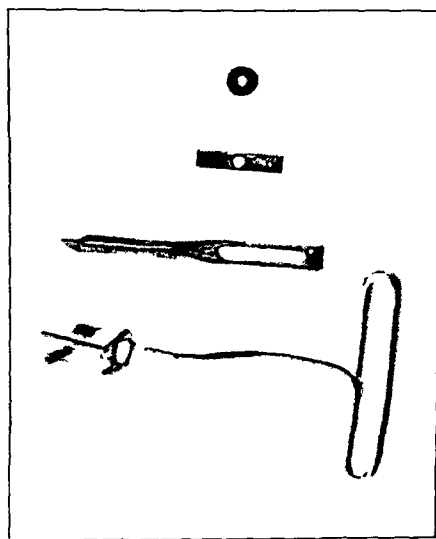


FIG. 1

Device disassembled. Thumb screw, shim, guide blade, and cylinder with handle.

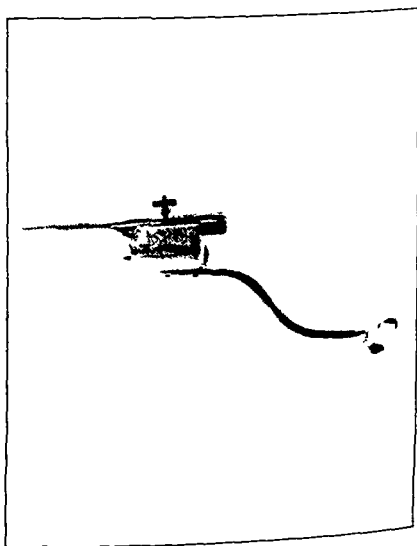


FIG. 2

Device assembled.

position in the anteroposterior plane. The placement in the lateral plane is more difficult. A device which would positively ensure correct placement in this plane should be of material assistance. With this in mind, the author conceived the device described in the following paragraph. It is readily seen to be derived from the Bailey guide.

This device (Fig. 1) consists of a flat, spade-pointed guide blade, seven and one-half inches in length, fitted to a groove in the outside of a cylinder, one-half an inch in inside diameter, in which it is held by a thumb screw. There is a shim for the variation of the amount of offset of the blade from the center line of the cylinder to allow for variations in anteroposterior diameter of the neck of the femur. This is rarely used, because the device without the shim was made after measurement of a number of anatomical specimens, and it was found that the variation of anteroposterior diameter of the neck was small,—not over one-quarter of an inch. Since the guide uses only one-half of this distance, the error is reduced to one-eighth of an inch, which is negligible in most cases. Without the shim, the center line of the cylinder is three-quarters of an inch from and parallel to the blade when in place. The shim might be used to advantage in a very large individual. With it, the blade offset is seven-eighths of an inch. The butt of the blade is slotted in that portion which fits into the groove in the side of the cylinder to allow for adjustment to variations in length of the neck of the femur. There are two sharp points, right and left, on the end of the cylinder, one of which will impinge on the shaft below the greater trochanter and assist in the maintenance of position of the device. The end of the cylinder is beveled to permit close approximation to the subtrochanteric surface of the bone. There is a rather large handle attached to the device to facilitate its placement. The device is shown assembled in Figure 2.

The use of the device will be described in an actual case, the original roentgenogram of which is shown in Figure 3.

The usual reduction by gentle traction, 20 degrees of internal rotation, and moderate abduction is carried out and checked roentgenographically. By means of this roentgenogram, it is possible simply and accurately to determine the length of nail needed. This method of measurement has been described by Schanz and others. A small bar, about one-half an inch by six inches by one-eighth of an inch and notched at each quarter inch, is placed at the level of the center of the greater trochanter in the coronal plane and parallel to the table. This is projected on the plate with the same magnification given the femoral neck and head, and, by means of caliper comparison, the length of nail to be used is readily determined (Fig. 4). In this case it is three and one-half inches. It will be seen that in this case there is slightly too much abduction. This has been corrected in Figure 5.

A lateral linear incision is then made from the top of the trochanter downward about four inches. Experience in its placement will permit the incision to be much shorter. Incision is then carried through the fascia



Fig 3  
Original roentgenogram

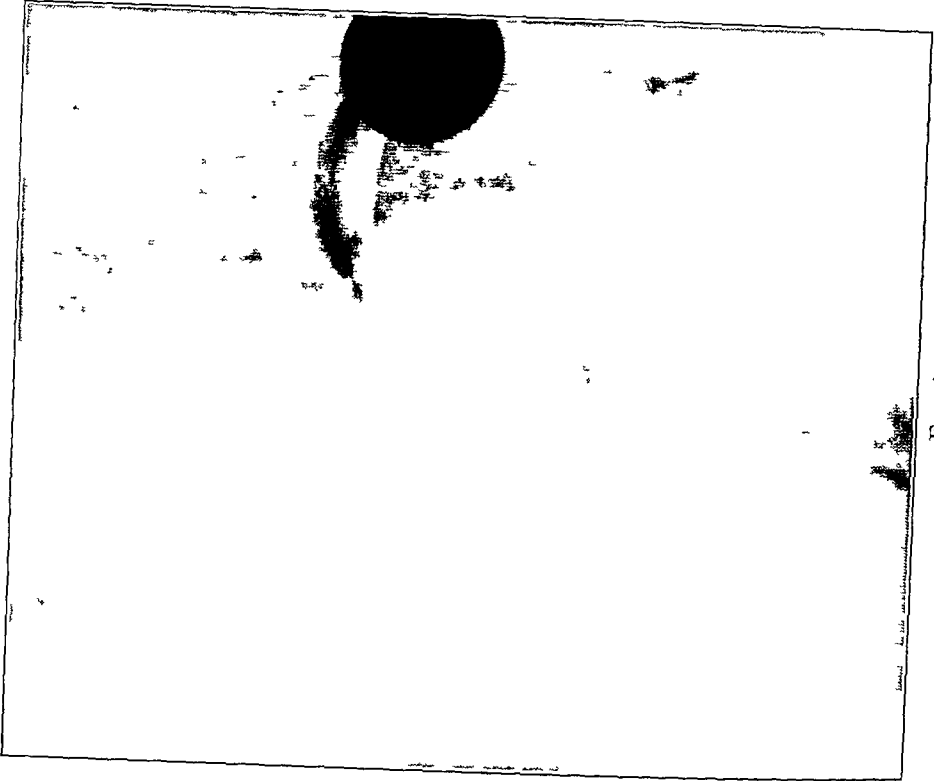


Fig 4  
After reduction, which shows too much abduction  
device projected on film Measuring

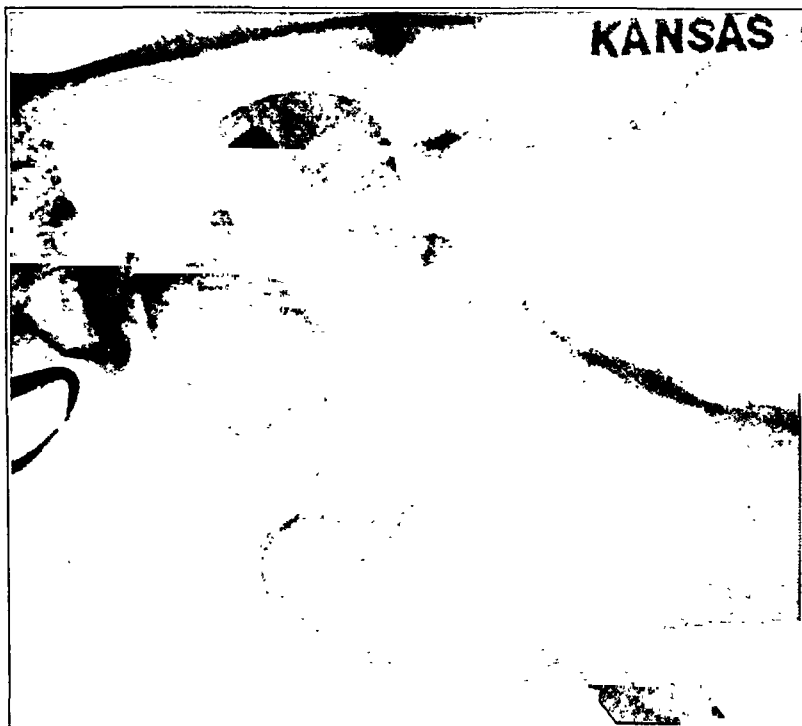


Fig. 6  
Anteroposterior view of nail in place.

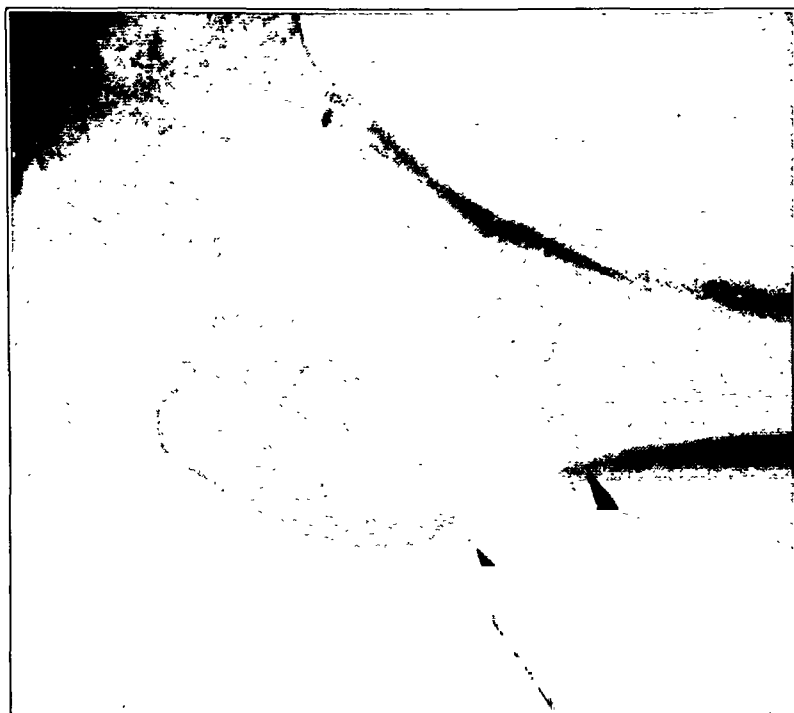


Fig. 5  
Anteroposterior view, showing device in place. Excessive abduction has been corrected.



FIG. 7

Lateral view of nail in place.

lata and the vastus lateralis muscle down to the periosteum. The index finger can then be passed beneath the fascia lata and anterior to the origin of the vastus lateralis along the anterior surface of the neck of the femur, outside the capsule, up to the femoral head. The thumb screw on the guide is then loosened, and the blade is inserted along the anterior surface of the neck through the fibers of origin of the vastus lateralis and the vastus intermedius as near the anterior surface of the neck as possible, and inside the capsule up to the femoral head. With the finger, its entire length can be felt through the capsule. The cylinder is then slipped up until the point touches the shaft beneath the trochanter. The thumb screw is tightened, and the base of the cylinder is struck sharply with a mallet. This blow impacts the point on the cylinder into the cortex about one-eighth of an inch and the point of the blade the same distance into the flare of the femoral head. The points on the blade and cylinder then maintain the position of the guide and may help to prevent subsequent displacement of the head while the nail is being driven.

A single anteroposterior roentgenogram is then taken to determine that the blade is parallel to the neck of the femur (Fig. 5). Light pressure on the handle by an assistant maintains the guide in position while the nail is being driven. The selected nail is attached to the holder and driven through the cylinder into the femur. It must transfix a line almost at the

exact center of the neck and head, since the guide blade is parallel to and three-quarters of an inch from the center of the line of direction of the nail. Position and depth of impaction are then checked by anteroposterior and lateral roentgenograms (Figs. 6 and 7). The guide is removed, and the incision is closed.

In this case the operating time was fifteen minutes. This is, of course, possible only with the cooperation of roentgenologists capable of returning roentgenograms within one and one-half minutes. The incision was made immediately after measuring on the roentgenogram the length of nail needed (Fig. 4).

#### SUMMARY

By means of the device described, the Smith-Petersen nail may be positively and simply placed in correct position without guide wires. The device is presented in the belief that the principles on which it is based are mechanically sound, and that its use will simplify the operative procedure and materially shorten the operating time, with benefit to the patient and satisfaction to the surgeon. Modifications for insertion of any type of internal fixation for fractures of the neck of the femur can readily be made.

## A DOUBLE-BAR PLASTER BACK SUPPORT

BY J. M. MITCHNER, M.D., HOUSTON, TEXAS

The double-bar plaster back support shown in Figures 1-A and 1-B has been used during convalescence in fractures of the vertebrae, spondylitis, strains, laminectomy of the second, third, and fourth lumbar vertebrae for the removal of a ruptured nucleus pulposus, etc. It has also been employed in cases of low-back pain. In the latter cases, after a few days, the upper portion has been removed at the nipple line in males and under the breast in females, or the bars have been placed only between the two circular bands at first, the pelvic band being made wider and lower and being trimmed for comfort in sitting. It is especially useful in cases in which a metal support is not available or is prohibited because of expense. It should also prove helpful aboard ship and in isolated communities. This support suggests the possibility of many modifications and uses.

The application of the splint is as follows: A piece of tubular stockinet is applied to the body of the patient. This should be of sufficient length so that the upper end may be split on either side and brought over the shoulders, where it is either sewed together with a few stitches or strapped with a piece of wide adhesive plaster, and the lower end may be turned up on the pelvic band to secure a smooth edge. A piece of thick felt is placed on either shoulder. In Figure 1-A these pieces of felt have been



FIG. 1-A



FIG. 1-B



left long, so that they may be seen. This same photograph shows a piece of felt placed between the breasts where the front bars are crossed. This has been purposely pulled to one side, so that it may be seen. These pieces of felt may be stitched to the stockinet if they have a tendency to leave their position. At times difficulty is experienced in molding lumbar supports properly, and a space remains between these supports and the back. In such an event, this space may be filled in with suitable thicknesses of felt, and they are stitched either around the plaster or to the stockinet.

In heavy patients it may be necessary to incorporate a strip of molded duralumin or tin in the lumbar portion to increase the strength of the plaster and at the same time to reduce its weight and bulk.

Several turns of plaster, two, three, or four inches wide, are made about the chest and also about the pelvis below the crest of the ilium. The width of plaster used depends upon the size of the patient. Two "reinforcements", of sufficient length to extend from the lower margin of the pelvic band in the back and over the shoulders to the lower margin of the pelvic band in front, are placed on the patient. In back, these reinforcements are placed over the posterior superior iliac spines and are split to go on either side of these processes if they are prominent. In front, they are placed inside the anterior superior iliac spines. After these strips have been molded, they are caught with more rolls of plaster on top of the two circular bandages which have already been applied. The stockinet at the bottom is turned up and incorporated in the last bandage about the pelvis. A three-inch gauze bandage is then wrapped around the body to secure a snug fit. The patient is kept in a sitting or a standing position until the plaster is dry. The gauze bandage is then removed. If the patient is laid down on a hard surface, with a pillow under the lumbar area, there is a tendency for the portions above the upper band to bulge and the bars in front between the circular bands to buckle.

The durability of the support depends upon the quality of the material used, the workmanship of the surgeon, and the care given it by the patient. Ordinarily such a support will last for several weeks. On our Service we have not made these supports removable, but there is no reason why they cannot be cut and straps fastened to the plaster for this purpose. If desired, the stockinet may be split in suitable places and brought over the outer side of the plaster strips and sutured. The fact that it is light and "air conditioned" is an advantage in a warm climate.

The photographs were taken by Dr. G. C. Lechenger, roentgenologist, at Jefferson Davis Hospital, Houston, Texas.

# AN ADJUSTABLE REAMER FOR USE IN ARTHROPLASTY OF THE HIP

BY PAUL L. NORTON, M.D., BOSTON, MASSACHUSETTS

*Assistant Orthopaedic Surgeon, Massachusetts General Hospital, Boston*

The use of vitallium molds in arthroplasty of the hip has stimulated renewed interest in the subject of hip surgery. The operative technique has been described by Smith-Petersen,<sup>1</sup> and the results obtained were recently shown to members of the American Academy of Orthopaedic Surgeons.

Skillfully designed tools have played an important part in the excellent results which have been obtained. The operation is facilitated by the use of the two Smith-Petersen hip gouges and special female reamers. These reamers, of which there were six, were made over a period of years at considerable expense.

The adjustable instrument to be described was designed to replace the six reamers. It has been given a long and thorough trial. It will give best results when used in conjunction with the special hip gouges.

The instrument consists of two bells (Fig. 1). The upper or movable bell turns clockwise on a threaded shaft (Fig. 2) to allow it to open. The shaft is machined to fit the handle of the Hudson drill. The lower bell or reamer is composed of four blades, jointed to the shaft through freely

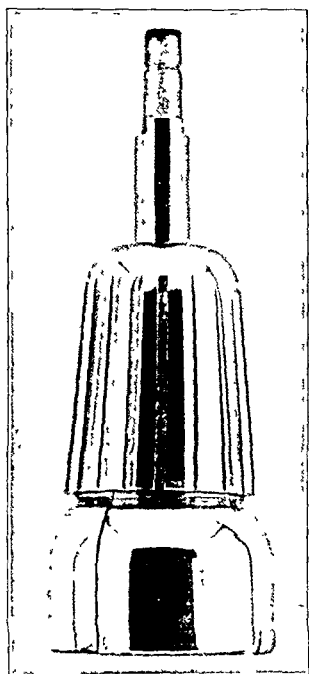


FIG. 1

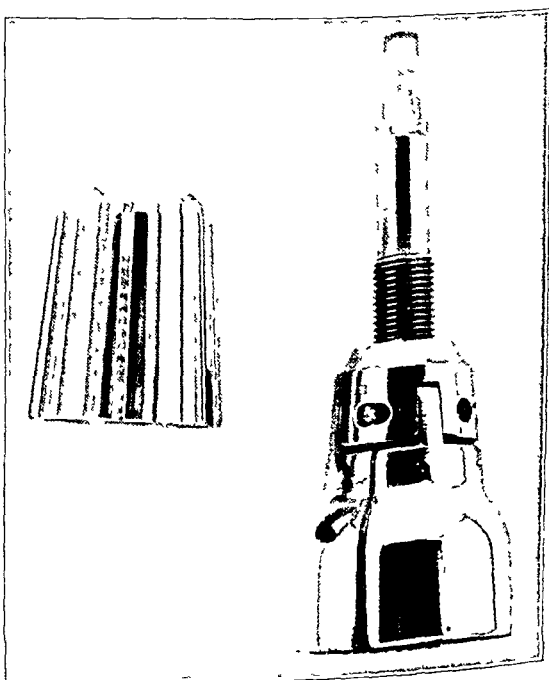


FIG. 2

moving joints. Each blade has a set of sharp cutting teeth on the inner surface (Fig. 3). The curvature of the blades has been planned to correspond to the various sizes of the vitallium cups designed by Smith-Petersen.

The reamer is used as follows: After the femoral head has been reshaped by the special hip gouges, the adjustable reamer is placed over the head and the locking bell is turned counterclockwise to unlock the leaves.

The reamer should fit loosely over the femoral head. It is then rotated until all the high spots have been smoothed down. The upper or locking bell is then turned down (clockwise), gradually closing the leaves, and the reaming is repeated until the desired size has been obtained. If the reamer is tightened too much, it may jump or stick. When it is desired to ream only the top of the head, the reamer is opened widely, so that the cutting is done only by the domed portion of the blades.

The instrument has positive control in closing the blades. Pressure against the femoral head forces them open and locks them against the upper bell. A mechanism to open the blades made the cost of the reamer excessive and offered no particular advantages over the simple model.

1. SMITH-PETERSEN, M. N.: Arthroplasty of the Hip. A New Method. J. Bone and Joint Surg., XXI, 269, April 1939.

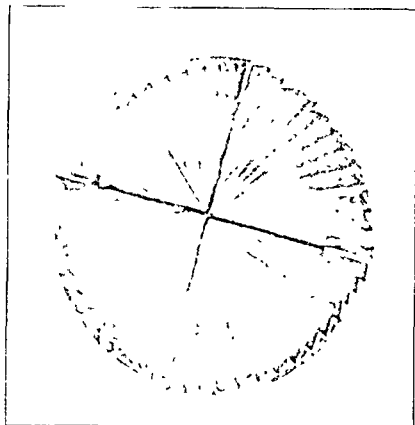


FIG. 3

### Correction

*The Journal* regrets that in the article on "Treatment of Congenital Torticollis" by Dr. Robert Soeur, which was published in the January 1940 issue, the word "second" was inadvertently omitted from the last sentence on page 37. This sentence should read: "Eventually, through the same incision and according to the same technique, the *second* lower insertion of the muscle is cut."



NAUGHTON DUNN

1884-1939

The early death of Mr. Naughton Dunn, which occurred on November 19 of last year, after a long, distressing illness, has deprived British orthopaedic surgery of one of its outstanding figures and the British Orthopaedic Association of its President, a post which he held during 1938 and 1939.

Mr. Dunn was born in Aberdeen in 1884 and was educated in the Grammar School and University of that City, graduating in Medicine in 1909. His interest in orthopaedic surgery began with his appointment as House Surgeon to the late Sir Robert Jones at the Royal Southern Hospital, Liverpool, some years before the Great War. From this association there was developed between the teacher and pupil a firm friendship, which endured until the former's death.

Following his training in orthopaedic surgery, he transferred to Birmingham,

where he became associated with the Birmingham Cripples' Union, and through his instrumentality the organizations for the treatment of the cripple in the Birmingham district were gradually joined together, and, in place of a number of scattered societies, whose work necessarily overlapped, the present Royal Cripples' Hospital was established.

Wider recognition of the value and originality of his work came to him through his efforts during and after the Great War. He was one of that small band of British surgeons who were called on by Sir Robert Jones to carry out preventive and corrective surgery in the British Army, a task which they were able to accomplish only through the generous help of their American colleagues.

Returning to Birmingham after the War, he continued his work at the Royal Cripples' Hospital and at the Robert Jones and Agnes Hunt Orthopaedic Hospital in Oswestry, an institution in which he played a particularly vital part.

Mr. Dunn received many honors, but of them all probably the one he treasured most was the honorary LL.D. which was conferred upon him by his own University of Aberdeen in 1937. He was connected with many hospitals in the Midlands, both in an active and in an advisory capacity, and he held the very important post of Lecturer in Orthopaedic Surgery at the University of Birmingham. He was one of the original members of the British Orthopaedic Association and for a number of years served on the Executive Committee. He also held the office of President of the Orthopaedic Section of the Royal Society of Medicine and was a corresponding member of the American, French, and Australian Orthopaedic Associations.

Although Mr. Dunn's contributions to the literature of orthopaedic surgery were not as numerous as one would have expected from a surgeon of his standing, yet what they lacked in quantity was compensated by their extreme soundness and breadth of vision. They were typical of the man—inherently sound, sane, and thoughtful—and characterized by an underlying care for the patient, which was always his first anxiety. His most notable contribution, which brought him an international reputation, was his work on the operative treatment of paralytic deformities of the foot.

As a man he was extremely popular, and the finest memorial which could be erected to him is already present in the devotion of that large group of young surgeons who came under his influence in their training, which he gave so generously in his many clinics in Birmingham and Oswestry. Such a gap would be hard to fill at any time, but especially so during this trying period when wise counsel and stimulating leadership are so urgently needed.

## JOHN PRENTISS LORD

1860-1940

Orthopaedic surgery has again lost one of its older and outstanding personalities in the Missouri Valley. Dr. John Prentiss Lord, of Omaha, Nebraska, suddenly at Coral Gables, Florida, on March 3, 1940.

Dr. Lord was born near Dixon, Illinois, on April 17, 1860. His early education in the local schools and Ferris Academy. His medical education was received at the Medical College, from which he was graduated in 1882. During the following two years he built up a general practice in Creston, Illinois. There he married Miss Minnie Up Swingley, of Rockford, Illinois, and for almost fifty years their lives were closely interdependent. After four years of general practice in western Illinois, he went to New York for postgraduate study in preparation for work in the field of surgery, which at that time was developing with rapid strides.

Although Dr. Lord devoted the earlier decades of his career to general surgery, he did the pioneer work in orthopaedic surgery for the upper Missouri Valley. It was his personal influence that procured for Nebraska the State Orthopaedic Hospital in 1905. As Surgeon-in-Chief of that Institution until 1917 he directed its surgical and administrative policies. This work was interrupted by service in the Army Medical Corps, where he was Chief Instructor in Military Orthopaedic Surgery at Fort Riley. Since 1918, Dr. Lord had limited his activities entirely to orthopaedic surgery. He was a striking representative of that group of doctors who, from an early general practice, have given special attention to general surgery and finally have limited their practice to the special type of surgery in which they have proved themselves particularly adept.

As a teacher, Dr. Lord has impressed his personality upon a large group of doctors. He was Professor of Anatomy at the Creighton Medical College in 1891, and, in 1898, was appointed Professor of Surgery, and Attending Surgeon to St. Joseph's Hospital. This work was continued until 1913, when he accepted the position of Professor of Orthopaedic Surgery at the University of Nebraska College of Medicine. There he continued his active teaching and supervision of the Department in the University Hospital until 1932, when he retired to become Professor Emeritus.

Dr. Lord's activity in his profession is indicated by the numerous societies with which he was affiliated. He had been President of the Omaha-Douglas County Medical Society, the Omaha Mid-West Clinical Society, the Nebraska State Medical Association, the Sioux Valley Medical Association, the Medical Society of the Missouri Valley, the Clinical Orthopaedic Society, and the Western Surgical Association. He had also been Chairman of the Orthopaedic Section of the American Medical Association. Dr. Lord was a charter member of the American College of Surgeons, being one of its first Nebraska Governors, and also of the American Academy of Orthopaedic Surgeons. He was elected to membership in the American Orthopaedic Association in 1911.

Dr. Lord's sense of responsibility to his community was great, and he took an active interest in the business, educational, and religious activities of Omaha.

In the professional world, Dr. Lord's initiative, originality of approach, and familiarity with both old and new surgical procedures commanded the respect of his colleagues. An open mind was one of his outstanding possessions. Surgical problems intrigued him. Consistent attendance at both local and national medical meetings was regarded by him as a personal obligation to his patients.

Dr. Lord's heritage was that of early English and New England family life, coupled with the pioneer spirit which directed lives toward the newer western lands. His philosophy of life, personal integrity, and active interest in education and religion were possessions emanating from the sterner existence of that earlier day.

## GEORGE WALLER HAWLEY

1874-1940

Dr. George Waller Hawley died on January 1, 1940, at his home in Westport, Connecticut, following an illness of ten years.

Dr. Hawley was born on July 24, 1874, in Bridgeport, Connecticut, where he received his early education. He attended St. Paul's School, in Concord, New Hampshire, and was graduated from Sheffield Scientific School at Yale in 1896. Following his graduation from Cornell University Medical College in 1899, he served as an intern at Bellevue Hospital, New York City. At the completion of his internship, he went to Vienna, where he took a postgraduate course at the *Medizinische Fakultät der Universität Wien*. Upon his return to the United States, he became consulting orthopaedic surgeon at the Greenwich, Milford, and Derby Hospitals and was on the staffs of the Bridgeport Hospital and the Hospital for the Ruptured and Crippled, New York City. He later joined the faculties of Cornell University Medical College and New York Post-Graduate Medical School, and was an organizer of the Fracture Committee of the American College of Surgeons in 1916.

During the World War, Dr. Hawley served in France from 1917 to 1919 with Base Hospital No. 9 from the New York Hospital. He was in charge of the Orthopaedic Division and early in 1918 was advanced to the rank of Commanding Officer. The Hospital became an Observation Center, where, under Dr. Hawley's guidance, early contacts with war surgery were made by orthopaedic surgeons arriving in France. As Commanding Officer, Dr. Hawley demonstrated an unusual ability as an administrator, combining most successfully the executive and the professional points of view. His courtesy, fairness, and personal interest quickly commanded the respect and full cooperation of the Hospital personnel. Returning to the United States with the rank of Lieutenant Colonel, he was assigned to the Army Medical School in Washington, and, following his discharge from the Army, he resumed his practice in Bridgeport.

Dr. Hawley held membership in many professional organizations,—the American Medical Association, the American College of Surgeons, the New York Academy of Medicine, the New England Surgical Society, and the American Orthopaedic Association, as well as a number of local societies. In recognition of his contributions to surgery during the War, the French Government conferred upon him the title of "*Officier de l'Académie de l'École des Beaux Arts*".

Endowed with unusual mechanical ability, Dr. Hawley also had the faculty of applying mechanical principles to practical use in the treatment of many surgical conditions. Always interested in the treatment of fractures, he designed the fracture table which bears his name and demonstrated it before the American College of Surgeons in Washington in 1921. This table revolutionized fracture treatment by the added facilities which it afforded and its accuracy of adjustment, and it stimulated the construction of similar appliances, all of which were based on the principles embodied in Dr. Hawley's original device. In 1932, Dr. Hawley made a further contribution to the treatment of fractures when he completed his second fracture table, which combined the x-ray and the fluoroscope with the original table, enabling the surgeon to watch and to guide the bone fragments during reduction.

Elected to membership in the American Orthopaedic Association in 1915, Dr. Hawley was a constant attendant at its meetings, participating in the scientific sessions and taking an active interest in the general proceedings. He had the faculty of throwing himself wholeheartedly into the solution of the problem with which he was engaged, and he worked on it with an intensity which was a factor in his success. Although illness forced him to retire from practice, it could not curb his active mind or dim his keen interest, and he continued his research and study, making frequent contributions to scientific journals. He is held in affectionate and grateful remembrance by his fellow members not only for his distinguished contributions to orthopaedic surgery but also for his courageous spirit and capacity for loyal friendship.

## ZABDIEL BOYLSTON ADAMS

1875-1940

Dr. Zabdiel Boylston Adams died suddenly at his home on March 16, 1940, in his sixty-sixth year. He was born in Framingham, Massachusetts, in 1875, the son of Dr. Zabdiel Boylston Adams and Frances (Kidder) Adams. His father was a physician of prominence and wide reputation, and the son followed naturally in his footsteps.

After three years at Massachusetts Institute of Technology, he entered Harvard Medical School, graduating in 1903. He early became interested in orthopaedic surgery and, after a surgical service as intern at the Boston City Hospital, established himself in Boston in the practice of his chosen specialty.

In 1907 he married Helen Foster of Brookline, who survives him, together with a sister, Mrs. Frances Adams Wallace of Pasadena, California, two children, Mrs. Benjamin Patterson Bole of Cleveland, Ohio, and Samuel Adams of Little Rock, Arkansas, and two grandchildren.

He served as Assistant Surgeon at the Boston Children's Hospital during 1905, as Orthopaedic Surgeon at the Massachusetts General Hospital from 1906 to 1924, as Chief of the Orthopaedic Service in 1923, and, since 1925, as Consulting Orthopaedic Surgeon at the Lakeville State Sanatorium, where he conducted a large and active service in the department of tuberculosis of the bones and joints.

He was Instructor in Orthopaedic Surgery at Harvard Medical School from 1918 to 1924 and Associate in Anatomy at Harvard Medical School from 1919 to 1924. His thorough knowledge of anatomy, combined with an unusual degree of mechanical ability and skill, which had been still further developed by his courses at the Massachusetts Institute of Technology, furnished a sound basis for his work in orthopaedic surgery. He worked with intensity on the problems with which he was occupied and gave himself to both his hospital and private work with this spirit of devotion. At times he made special investigations and studies of the principles and methods of treatment of scoliosis and congenital dislocation of the hip, at a period when the lack of fuller knowledge rendered the care of these cases difficult. In more recent years he devoted much of his energy to creative work; his orthopaedic experience, combined with his knowledge of mechanical principles, enabled him to provide sufficient support and protection to special types of deformed feet, and he developed a method which will result in permanent benefit in the treatment of these cases.

At the time of our entrance into the World War, Dr. Adams was a member of the Medical Reserve Corps and went into active service in 1917, serving first as Captain and later as Major with Base Hospital No. 6 at Bordeaux. He remained with that organization until transferred to special duty, when he was placed in command of the Special Training Battalion at Harchechamp, where he was given charge of the rehabilitation of groups of men, so that they might return to active service at the front. This was a difficult task, but he accomplished it with an efficiency that made the camp a definite success. At the expiration of his duty with the Battalion, he returned for a time to Base Hospital No. 6 and later went to Base Hospital No. 114, at Beau Desert. On his return to the United States he was assigned to hospital duty, caring for the wounded soldiers, until his discharge from active service.

Dr. Adams was a member of the American Medical Association, the American Orthopaedic Association, of which he was President in 1929, and an Honorary Member of the American Academy of Orthopaedic Surgeons; he also held membership in the International Orthopaedic Association, the Massachusetts Medical Society, and several local medical societies. He was a valued and efficient member of the Board of Associate Editors of *The Journal of Bone and Joint Surgery*.

In his early childhood he was the companion of his father, who was unusually familiar with birds, flowers, and nature study, and who gave to the boy of his knowledge and instilled in him a love of Nature which never waned but remained a lure during his entire life. The study of birds, bird life, and wild flowers was a passion with him, and his knowledge of them was profound and was a constant source of satisfaction to himself and of pleasure and enjoyment to his friends. His companionship with living Nature





ZABDIEL BOYLSTON ADAMS

exerted a strong influence on his character and furnished an emotional outlet for a temperament naturally reserved and sensitive.

Dr. Adams was a typical New Englander, with strong, uncompromising convictions which had come down by inheritance from the rugged character of the early Puritans. He had an innate sense of justice and was intolerant of anything which suggested insincerity, and he never temporized in his dealings with what he felt to be right. This made him strong in his dislikes and generous and loyal to his friends. These characteristics made themselves evident by an outspoken frankness and directness, which, although not always tactful, was the expression of his firm convictions and rather endeared him to his friends, who recognized in this trait an evidence of his integrity and honest thinking.

The profession has lost an outstanding member; his patients, a friend as well as a physician; and his associates, a valued companion.

# News Notes

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The Fifty-Fourth Annual Meeting of **The American Orthopaedic Association** will be held in Kansas City, Missouri, May 6, 7, 8, and 9, 1940, under the presidency of Dr. Frank D. Dickson. Headquarters will be at the Hotel President. The morning of the first day is to be devoted to a clinical program at the Hotel President. The scientific program for the other three days will be as follows:

## TUESDAY, MAY 7

### *Morning Session*

A Study of Poliomyelitis Disabilities in Relation to Obstetrical Practice.

Dr. S. I. Kleinberg, New York, N. Y.

Dr. Thomas Horwitz, Philadelphia, Pennsylvania. (By invitation.)

Chemistry of Normal and Arthritic Cartilage.

Dr. George Wagoner, Philadelphia, Pennsylvania.

Operations on Arthritic Knees.

Dr. G. E. Haggart, Boston, Massachusetts.

Treatment of Scoliosis by Combined Methods.

Dr. Arthur Steindler, Iowa City, Iowa.

A Study of Over 100 Paralytic Scoliotics.

Dr. Paul C. Colonna, Oklahoma City, Oklahoma.

Dr. Frederick Vom Saal, Oklahoma City, Oklahoma. (By invitation.)

### *Afternoon Session*

Acetabuloplasty: An Analysis of Results.

Dr. M. N. Smith-Petersen, Boston, Massachusetts.

Address by Guest Speaker.

Subtrochanteric Osteotomies—Indications for Special Types.

Dr. Frederick C. Kidner, Detroit, Michigan.

Bifurcation Osteotomy.

Dr. Rudolph S. Reich, Cleveland, Ohio.

A Survey of Orthopaedic Research in the United States and Canada.

Dr. A. R. Shands, Jr., Wilmington, Delaware, *Chairman of Research Committee.*

## WEDNESDAY, MAY 8

### *Morning Session*

Candidate's Thesis—Committee Selection.

President's Address.

Dr. Frank D. Dickson, Kansas City, Missouri.

Symposium: The Incidence, Significance, and Treatment of Sciatic Pain in Low-Back Cases.

Dr. Fremont A. Chandler, Chicago, Illinois, *Chairman.*

Anatomical Variations as well as Roentgenographic Appearances of the

Low Back in Relation to This Subject.

Dr. Theodore A. Willis, Cleveland, Ohio.

Neuro-Anatomy and Physiology—Significance of Sciatica.

Dr. W. McK. Craig, Rochester, Minnesota. (By invitation.)

Conservative Treatment.

Dr. John G. Kuhns, Boston, Massachusetts.

**The Intervertebral Disc.**

Dr. Joseph S. Barr, Boston, Massachusetts.

Dr. William Jason Mixer, Boston, Massachusetts. (By invitation.)

**Lumbosacral Lesions with the Exception of Spondylolisthesis.**

Dr. Benjamin P. Farrell, New York, N. Y.

**Sacro-Iliac Conditions.**

Dr. M. N. Smith-Petersen, Boston, Massachusetts.

**Spondylolisthesis in Its Various Phases in Its Relation to the Subject.**

Dr. Henry W. Meyerding, Rochester, Minnesota.

**Fascia.**

Dr. Frank R. Ober, Boston, Massachusetts.

Dr. Clarence H. Heyman, Cleveland, Ohio.

Dr. Albert H. Freiberg, Cincinnati, Ohio.

**Facets and Ligaments.**

Dr. Carl E. Badgley, Ann Arbor, Michigan.

*Afternoon Session***Discussion of the Symposium:****Conservative Treatment.**

Dr. George E. Bennett, Baltimore, Maryland.

**The Intervertebral Disc.**

Dr. Lawson Thornton, Atlanta, Georgia.

Dr. W. McK. Craig, Rochester, Minnesota. (By invitation.)

**Stabilizing Operation.**

Dr. Rex L. Diveley, Kansas City, Missouri.

Dr. James S. Speed, Memphis, Tennessee.

**Fascia and Muscle Release.****Spondylolisthesis.**

Dr. Harold H. Hitchcock, Oakland, California.

Dr. Halford Hallock, New York, N. Y.

**THURSDAY, MAY 9***Morning Session***Two-Stage Side Transplantation of the Fibula for Complicated Pseudarthrosis of the Tibia.**

Dr. Philip D. Wilson, New York, N. Y.

**Legg-Perthes Disease.**

Dr. A. Bruce Gill, Philadelphia, Pennsylvania.

**Claw-Foot.**

Dr. Wallace H. Cole, St. Paul, Minnesota.

**The Effect of Local Implantation of Sulfanilamide in Joints and Other Tissues.**

Dr. John Albert Key, St. Louis, Missouri.

**Sulfanilamide in the Treatment of Compound Fractures.**

Dr. Willis C. Campbell, Memphis, Tennessee.

The first Executive Session will be held on Tuesday, May 7, at 12:00 noon, and the second Executive Session on Thursday, May 9, at 12:00 noon.

The Annual Golf Tournament will take place on Monday afternoon, May 6, and the Annual Dinner will be held on Wednesday evening, May 8.

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The American Physicians' Art Association will hold its Annual Art Show at the Belmont-Plaza Hotel, New York City, June 10 to 14. This exhibit will be held in conjunction with the Convention of the American Medical Association. Detailed information may be obtained from the Executive Secretary, Dr. F. H. Redewill, 526 Flood Building, San Francisco, California.

The next examination of **The American Board of Orthopaedic Surgery** will be held in Chicago, Illinois, on June 15 and 16, 1940. Applications for this examination must be filed with the Secretary, Dr. Fremont A. Chandler, 6 North Michigan Avenue, Chicago, Illinois, on or before April 15, 1940.

The Secretary of the Board reports that a total of 652 men have been granted the certificate of the Board. Examinations are held twice annually, but, as the number of applicants diminishes, they probably will be held but once a year.

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Dr. Sidney Sideman has moved his offices to The Monroe Building, 104 South Michigan Avenue, Chicago, Illinois.

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Dr. Donald C. Somers announces the removal of his office to 710 David Whitney Building, Detroit, Michigan.

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Prof. Aladár Farkas, of Budapest, is now in the United States, where he is engaged in teaching and research on the subject of paralytic scoliosis in the Department of Orthopaedic Surgery at the State University of Iowa, Iowa City, Iowa.

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The **American Society for the Control of Cancer**, through organized units of its Women's Field Army, will conduct during April its fourth annual campaign of cancer education. Detailed information in regard to the campaign may be obtained from the headquarters of the Society, 350 Madison Avenue, New York, N. Y.

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The Sixty-Ninth Annual Meeting of the **American Public Health Association** will be held in Detroit, Michigan, October 8 to 11, with the Book-Cadillac Hotel as headquarters. A Health Exhibit will be held in connection with the meeting, and an Institute on Health Education is scheduled prior to the official opening. The Executive Secretary of the American Public Health Association is Dr. Reginald M. Atwater, 50 West 50th Street, New York, N. Y.

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The **Mississippi Valley Medical Society** offers annually a cash prize of \$100, a gold medal, and a certificate of award for the best unpublished essay on any subject of general medical interest (including medical economics) and practical value to the general practitioner of medicine. Certificates of merit may also be granted to the physicians whose essays are rated second and third best. Contestants must be members of the American Medical Association who are residents of the United States. Contributions should not exceed 5000 words, should be typewritten in English in manuscript form, should be submitted in five copies, and must be received not later than May 1, 1940. Further information may be obtained from the Secretary, Harold Swanberg, M.D., 209-224 W. C. U. Building, Quincy, Illinois.

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At a special meeting of the **Société Belge d'Orthopédie**, held in Liège on June 24 and 25, 1939, the main topic for discussion was "Metallic Osteosynthesis in Children". Dr. J. Verbrugge, Dr. R. Rombouts, and Dr. J. Massa, pupils of Dr. Lambotte of Antwerp, reviewed the case histories of 318 patients. Of these, 180 were operated upon by Dr. Lambotte; ninety, by the three surgeons presenting the report, and forty-eight, by Dr. Tavernier of Lyon. Their study was based on 109 of these cases which had had a

sufficiently long follow-up period with check-up roentgenograms. As a means of comparison, eighty-six cases of fractures in children, treated conservatively, were also presented. The conclusions derived from this study were as follows:

1. Metallic osteosynthesis in children is not dangerous.
2. The technique does not cause any serious complications.
3. It favors and hastens functional recovery.
4. It avoids the inconveniences of certain methods of orthopaedic treatment.
5. The metal is practically always well tolerated.
6. Metallic osteosynthesis is the technique of the future.

In the discussion that followed, Dr. Lambotte confirmed the views of his pupils and stated that he believed that osteosynthesis was indicated in 10 per cent. of all fractures of the extremities. Prof. Sorrel, on the contrary, felt that osteosynthesis was rarely necessary in children, and that, when indicated, simple open reduction with catgut suture of the periosteum and without the use of metal gave satisfactory results. Dr. Van Nes stated that he practised osteosynthesis after corrective osteotomies. Dr. Parisel felt that in children nails and screws should be removed two years after operation.

Other papers presented at this meeting were as follows:

A Case of Sudeck-Leriche Syndrome Cured by Acetylcholine—Dr. F. de Moraes, Rio de Janeiro.

Diaphyseal Resection as the Operation of Necessity and of Choice in the Treatment of Suppurative Staphylococcic Osteomyelitis—Dr. E. Sorrel and Dr. A. Guichard, Paris.

Arthrodesis of the Hip in Arthritis Deformans—Dr. P. C. Van Nes, Leyden.

A Case of Multiple Epiphysitis of the Metacarpophalangeal and Metatarsophalangeal Joints—Dr. Michotte, Brussels.

Tomography in Orthopaedic Surgery—Dr. Rombouts, Antwerp.

A Case of Ollier's Dyschondroplasia Reviewed after Ten Years—Dr. J. Van Haelst, Ghent.

The papers presented at this meeting are published in full in the *Bulletin de la Société Belge d'Orthopédie et de Chirurgie de l'Appareil Moteur*, Volume XI, Numbers 5 and 6, 1939.

The Fifth Assembly of the United States Chapter of the **International College of Surgeons** was held at the Florida Medical Center in Venice, Florida, February 11 to 14, 1940. Dr. Fred Albee, the President-Elect, was the host. Approximately 400 attended the meeting, and a large class was inducted into the International College of Surgeons.

The following program was presented:

Surgical Treatment of Giant-Cell Tumors of Bones — Prof. Alberto Inclán, Habana, Cuba.

Several Cases of Osteochondritis in Adolescents — Dr. Alfonso Ortiz-Tirado, Mexico City, Mexico.

The Treatment of Compound Fractures — Dr. Grover C. Weil, Pittsburgh, Pennsylvania.

Preliminary Observation of the Use of Venom in the Treatment of Spastic Paralysis — Dr. Thomas Wheeldon, Richmond, Virginia.

The officers elected for 1941 are as follows:

President-Elect: Dr. Desiderio Roman, Philadelphia, Pennsylvania.

First Vice-President: Dr. P. Brooke Bland, Philadelphia, Pennsylvania.

Second Vice-President: Dr. Duncan MacPherson, New York, N. Y.

Third Vice-President: Dr. Moses Behrend, Philadelphia, Pennsylvania.

Fourth Vice-President: Dr. Raymond W. McNealy, Chicago, Illinois.

Fifth Vice-President: Dr. R. B. Dillehunt, Portland, Oregon.

## BRITISH ORTHOPAEDIC ASSOCIATION

The British Orthopaedic Association held its Annual Meeting in London on Friday, December 8, 1939. This meeting, previously to have taken place in Cardiff, had been postponed because of the outbreak of war, and, for the same reason, a one-day meeting, devoted entirely to the presentation of short papers, was arranged instead of the usual two-day meeting. It took place at the Royal Society of Medicine, by the courtesy of the President and Committee, and was attended by a large number of members.

Owing to the recent death of the President, Mr. Naughton Dunn, the meeting was conducted by the Vice-President and President-Elect, Prof. T. P. McMurray, who opened the session with a warm tribute to the late President.

During the proceedings, the Annual General Meeting of members was held. New officers were elected and a scheme for the continuance of bi-annual meetings at readily accessible centers for the duration of the War was approved.

The Association Dinner was held on the same evening at the Langham Hotel. Among the distinguished guests present were Dr. J. H. Hebb, C.B., C.B.E., Dr. Allen Daley, Sir Alfred Webb-Johnston, and Dr. J. Trueta.

The following communications were made:

*The Treatment of Compound Fractures* by Dr. J. Trueta, Barcelona.

Dr. Trueta outlined the treatment which he had found highly successful in over 1000 compound fractures produced by aerial bombs during the Spanish Civil War. He emphasized the necessity for the speedy transfer of casualties to the hospital and for their proper segregation by experts on arrival. For the prevention and combating of sepsis, the following technique was found to be of the greatest value:

1. A careful excision of all damaged tissues, and particularly of muscle, preferably within two hours of the injury.

2. Adequate drainage of all cavities by sterile absorbent gauze.

3. Rigorous immobilization, secured in the vast majority of injuries by plaster-of-Paris applied directly on the skin without padding and without a window over the wound.

The only exception to the use of plaster-of-Paris was in those patients in whom there was doubt about the vitality of the tissues remaining after excision, or doubt about the total circulation of the limb. Gas gangrene had occurred in only one patient, and in only eight had it been necessary to remove the plaster because of cellulitis in the region of the wound. These complications could be recognized immediately by changes in the comfort of the limb and in the general condition of the patient, and, in Dr. Trueta's opinion, were not obscured from the expert surgeon by the plaster-of-Paris splint.

*Sacro-Iliac Tuberculosis* by Mr. H. J. Seddon, London.

One hundred and seventy-six cases of tuberculous disease of the sacro-iliac joint, collected from various open-air hospitals throughout England, were reviewed most comprehensively. It is a disease chiefly of young adults, and there are three distinct clinical types: (1) an isolated closed lesion, with a mortality rate over a six-year period of 10 per cent.; (2) an isolated lesion with sinuses, with a mortality rate over a six-year period of 25 per cent.; and (3) a lesion with or without sinuses, but accompanied by a lesion elsewhere in the body, with a mortality rate over a six-year period of 55 per cent. Abscess formation is very frequent. Bony ankylosis appears to be the usual end result of conservative treatment, even in the absence of secondary infection. Fusion of the joint by operation may be beneficial, but the merits of this procedure have not yet been clearly demonstrated. Recovery generally means that the patient will be able to return to full work, and relapse is very rare; some chronic invalidism is due to sinuses. Pregnancy does not cause relapse of the disease.

*Trauma to the Knee Joint* by Mr. A. O. Parker, Cardiff.

This paper dealt with fractures of the lateral tuberosity of the tibia. Disappointment with the result of conservative treatment was expressed, and Mr. Parker tenta-

tively suggested that in certain of these fractures a better reconstruction of the damaged articular plateau could be obtained by an open operation. From a limited experience he felt that the lateral meniscus, torn from its peripheral or central attachments, presented an obstacle to successful conservative reduction of the fracture more often than was realized.

*Amputations by Mr. P. Jenner Verrall, London.*

Mr. Verrall presented an abundance of most instructive information about amputations, gained from his long experience at Queen Mary's Hospital for the Limbless, Southampton. It is impossible, in a brief report, to do justice to Mr. Verrall's comprehensive and detailed survey of every step in operative technique and in the fitting of artificial limbs. Of his many useful hints, perhaps the one least commonly known was that nerves should never be crushed, ligatured, pulled down and cut short, or injected with alcohol. A plea was made for conservatism in the treatment of painful stumps, which are most efficiently dealt with by expert limb-fitting, by anodal galvanism, and by the development of an occupational interest.

*The Value of Irradiation in the Treatment of Primary Tumors of Bone by Mr. K. I. Nissen, London.*

This paper was a careful survey of ninety cases treated at the Westminster Hospital Radium Anneve during the past eight years. Many of them were inoperable, and irradiation was the only possible form of treatment. Implantation of radium needles or seeds was condemned and was not used in this series. External irradiation by deep roentgen rays or radium bomb is vastly superior, for it has the advantage of accurate dosage and control of direction without trauma to the tumor.

In tumors with a bulky stroma and relatively poor vascularity—for example, chondrosarcomata—irradiation is of little use, and the value of amputation or excision is undisputed. In *highly malignant and vascular osteogenic sarcomata* metastases occur so early that death is inevitable, no matter what treatment is employed. The best that irradiation can do is to retain a painless and useful limb for the remainder of the patient's life.

In *less malignant sarcomata* high dosage is necessary, and local recurrences take place about one year after the commencement of treatment. Further irradiation may control spiculated periosteal growth, but medullary extensions are most intractable.

In *Ewing's tumor* irradiation produces rapid resolution, which can be maintained until death.

*Osteoclastomata* of the extremities are best treated surgically, but large tumors of the trunk bones, which are grave surgical problems because of hemorrhage, sepsis, and incomplete removals with recurrence, often respond very well, after a transient increase in symptoms, to small doses of irradiation.

## THE AMERICAN ACADEMY OF ORTHOPAEDIC SURGEONS

The Eighth Annual Convention of The American Academy of Orthopaedic Surgeons was held at the Hotel Statler, Boston, Massachusetts, January 21 to 25, 1940, under the presidency of Dr. George E. Bennett, of Baltimore.

The morning of the first day was devoted to a clinical program presented by Dr. Albert H. Brewster, Dr. Joseph H. Shortell, Dr. Otto J. Hermann, Dr. Frank R. Ober, and Dr. M. N. Smith-Petersen. In the afternoon the members and guests were given the opportunity of visiting operative and dry clinics held at the Massachusetts General Hospital, the Children's Hospital, the Massachusetts Memorial Hospitals, Boston City Hospital, The Carney Hospital, and Robert B. Brigham Hospital.

The very full and interesting scientific program which occupied the other four days comprised the following papers:

*Symposium on the Treatment of Tuberculosis of the Spine*—Dr. A. Bruce Gill, Philadelphia, Pennsylvania, *Chairman*.

Following the introduction and outline of the symposium by the Chairman, Dr. A. Bruce Gill, the "Pathology" was discussed by Dr. J. Albert Key, St. Louis, Missouri. Dr. J. Burns Amberson, Jr., New York City, was invited to consider the "Pathogenesis and Medical Treatment". Papers on the "End Results of Treatment" were presented by the following: Dr. Walker E. Swift, New York, N. Y.; Dr. Mather Cleveland, New York, N. Y.; Dr. Henry W. Meyerding, Rochester, Minnesota; Dr. Fremont A. Chandler, Chicago, Illinois; the late Dr. Z. B. Adams, Boston, Massachusetts; Dr. R. I. Harris, Toronto, Canada (by invitation); Dr. Leo Mayer, New York, N. Y.; and Dr. Paul P. Swett, Hartford, Connecticut.

*Syphilitic Lesions of Bones and Joints*—Dr. Edwin D. Weinberg, Baltimore, Maryland. (By invitation.)

The author reported on his extensive studies of several hundred cases and emphasized the similarity between syphilitic bone and joint lesions and almost any other known bone and joint condition. The tibia is the most frequent site of involvement. Multiple lesions with extensive areas of destruction frequently cause no symptoms and are demonstrated only by roentgenographic examination. Positive serological findings do not necessarily mean that the bone lesions are specific, but the therapeutic tests often show whether the serological findings represent the bone lesion in question. The colored race is more susceptible to the disease than the white race.

*Malignant Joint Tumors (Synoviomata)*—Dr. Dominic A. DeSanto, Dr. Robert Tennant, and Dr. Paul D. Rosahn, New York, N. Y. (by invitation).

Synoviomata are described as malignant sarcomatous tumors arising from synovial tissues and found within joints, para-articular bursae, and tendon sheaths. They are more common than is generally supposed and clinically are often overlooked or diagnosed as fibrosarcomata, spindle-cell sarcomata, etc. In the cases studied, the average age was thirty-six years. The preoperative time was from six months to ten years, with an average of forty months. The symptoms consist of pain, dysfunction, and tumor. These tumors are malignant, because local excision results in prompt recurrence and pulmonary metastases. Calcifying soft-tissue masses in or about the joint are not an infrequent finding. In general, the results of treatment are disappointing, but earlier diagnosis and primary radical treatment may be expected to improve the prognosis.

*Tuberculosis of the Large Long Bones of the Extremities*—Dr. W. B. Carrell, Dallas, Texas, and Dr. H. M. Childress, Jamestown, New York (by invitation).

This analysis of ninety-nine cases of tuberculosis of the long bones (123 bones) was based on twenty-nine reported cases from the English literature and seventy cases obtained as the result of questionnaires sent to 250 leading orthopaedic surgeons in the United States. The majority of the lesions occurred in the tibia, the femur, and the humerus. Half of the patients were over twenty years of age. Twenty-five had active pulmonary tuberculosis. In regard to treatment, twenty-three had no specific treatment; forty-six had incision and drainage; and ten had curettage and primary closure. The latter treatment was the most successful. An unusual case of "multiple osseous tuberculoid lesions", in which the diagnosis could not be definitely established, but which was almost certainly of tuberculous origin, was presented in detail.

*Attainment of Good Posture by Use of Natural Reflex Mechanisms*—Dr. Royal Storrs Haynes, New York, N. Y. (By invitation.)

This was an extensive study of postural reflexes in experiments on dogs and cats. There are reflexes which affect the position of parts or segments of the body and the attitude of the body as a whole. These reflexes are part of the total pattern of behavior and subject to its control. In the human being there may be observed associated muscle actions which are practically identical with the patterns seen in experimental animals. They may be elicited with great precision by simple willed movements of the



body with resultant assumption of proper position and distribution of tone in muscles which maintain this position. Education in producing these reflex patterns is not difficult. Because, in employing them, use is made of a nervous integration developed with the evolution of the upright posture for its control, maintenance of a good posture requires less effort and soon becomes habitual.

*A Program for the Care of Crippled Children in New York City*—Dr. Vernon W. Lippard, New York, N. Y. (By invitation.)

This investigation revealed that there are 16,731 crippled children in the area of New York City, or 2.2 per 1000 of the total population. The annual income of 75 per cent. of these families was under \$2,000, and that of 38 per cent. was under \$1,000. Adequate hospital facilities were found to exist, but greater correlation between clinics and social agencies is needed. Follow-up care in hospital out-patient departments offers better results than in schools or health centers. Since many children cannot be physically rehabilitated, special educational facilities are necessary. Three types were recommended: (1) special classes in schools; (2) classes organized in hospitals, and (3) home instruction by visiting teachers.

*President's Address*—Dr. George E. Bennett, Baltimore, Maryland.

In this paper Dr. Bennett outlined the development of the treatment of injuries of the vertebrae, tracing it back as far as the Edwin Smith papyrus of ancient Egypt. Three case histories from this remarkable document illustrated the accuracy of the clinical descriptions of these injuries. The windlass-traction treatment of Hippocrates was described, and various mediaeval adaptations were recounted, including an Arabian attempt at reduction by standing on the patient's back. Paul of Aegina was credited with originating laminectomies, and Paré employed them in the Renaissance. Somering, in 1793, provided the first accurate pathological description of compressed vertebrae. Hyperextension treatment was first effectively used by Malgaigne, although it had been attempted 2000 years earlier by Hippocrates, who placed a pig's bladder beneath the lumbar vertebrae, but failed in his effort to inflate it.

*Treatment of the Cerebral Palsies*—Dr. Winthrop Phelps, Baltimore, Maryland.

Dr. Phelps reviewed the history of the treatment of cerebral palsy and gave the results of the most recent surveys as regards number of cases, distribution, and division of types. He included estimates of the amount of feeble-mindedness found in the total group and enumerated the difficulties in connection with terminology and classification. He found that 69 per cent. of the patients came within the normal limits of intelligence. Spasticity, athetosis, and ataxia were also discussed.

*Bone Tumors*—Dr. Charles F. Geschickter, Baltimore, Maryland.

In this paper Dr. Geschickter discussed the diagnostic features of the major forms of both benign and malignant bone tumors, including symptoms, physical and roentgenographic findings, and the clinical course. He summarized the surgical procedures and types of radiation therapy for the various types of tumors and presented data on more than 100 cases of bone sarcoma in which the patients survived more than five years after treatment.

*Treatment of Osteogenic Sarcoma*—Dr. Albert B. Ferguson, New York, N. Y. (By invitation.)

Contrary to the classical teachings, the author submitted that early amputation for osteogenic sarcoma may actually increase the mortality of the condition and that radiation and preliminary excision should be carried out first. The data drawn from his study of 400 registered cases tended to support his contention.

*The Conservative Treatment of Poliomyelitis with Paralysis*—Dr. Raymond E. Lenhard, Baltimore, Maryland.

The author made a careful study of the end results of 207 cases of poliomyelitis treated by conservative therapy at the Children's Hospital School, Baltimore, with

emphasis upon the problem of the return of muscle power. The following conclusions were reached:

1. The average period of optimum muscle recovery is one year and seven months.
2. Recovery does not depend on the degree of paralysis at onset.
3. No further gain in muscle power is to be expected from continuing physical therapy after the optimum return of power has apparently been reached, except in the abdominal musculature, where such therapy may be beneficial after more than two years.
4. Tendon transplantation does not increase the power of the muscle itself, but merely changes its mechanical function.

*Fat Embolism*—Dr. Carlo S. Scuderi, Chicago, Illinois.

The author demonstrated that quantitative total-blood-fat determinations are valueless in diagnosing the condition, and that it is not the amount of fat which causes harm, but the qualitative state of the fat droplets. Controlled study of 200 normal blood and urine specimens indicated that the fat droplets are negative in the unselected hospital case. The importance of the last few cubic centimeters of urine for fat-droplet determinations was demonstrated both *in vitro* and by the injection of oil in the pelvis of the human kidney. The results of experimental work showed the value of chest roentgenograms and the complete unreliability of surface-tension determinations for diagnosis. Experiments on the frog and the dog were undertaken to determine the exact mechanism of excretion of fat droplets in traumatic cases, and it was found that the fat droplets are excreted only through the tubules of the kidney.

*Surgical Approach in Supracondylar "T" Fractures of the Humerus Requiring Open Reduction*—Dr. George W. Van Gorder, Boston, Massachusetts.

Fractures of the condyle of the humerus present difficulties which often can be met only by open operation. The approach suggested in this paper is through a mid-line posterior incision over the elbow and the lower humerus. Particular care is taken to identify the ulnar nerve. The triceps fascia and tendon are exposed and cut in a U-shaped manner, starting from behind the lateral condyle, extending upward, transversely, and downward to make a tongue, and ending at the medial condyle. The distal or cut end of the triceps is then reflected backward, giving a better exposure than by any other approach. When the fragments have been plated or fixed, the triceps tendon and fascia are resutured, and the wound is closed.

*Cavus Feet*—Dr. Albert H. Brewster, Boston, Massachusetts, and Dr. Carroll B. Larson, Boston, Massachusetts (by invitation).

The results of follow-up examinations in thirty-three cases were reported. The average postoperative observation period was seven and nine-tenths years. Numerous operations were the rule: the thirty-three patients were subjected to ninety-two operations. The authors concluded that the most definitive treatment for cavus is triple arthrodesis, plus transplantation of the long extensor tendons of the toes to the metatarsal necks.

*Correction of Congenital Flat-Foot by Astragalar Shortening*—Dr. J. Warren White, Greenville, North Carolina.

Because the operations designed for this condition depend largely upon the construction of a solid bony longitudinal arch, and failure in obtaining bony union in this arch, or its subsequent collapse, defeats their purpose, the author has employed another principle. His operation consists in resection of a portion of the astragalar neck, osteotomy of the os calcis, and implantation of the resected wedge between the osteotomy planes of the os calcis. Thereby the concave outer border of the foot is made convex, the convex inner border of the foot is made concave, and the normal arc of the arch is restored.

*The Lambrinudi Operation for Drop-Foot*—Dr. Vernon L. Hart, Minneapolis, Minnesota.

This operation was first described in 1927 and again in 1933 by Lambrinudi of Guy's

Hospital, London. It consists in resection of the head and neck of the astragalus, parallel to the subastragalar joint, while the foot is held in a neutral position and resection of the upper surface of the os calcis. A niche is made in the metatarsal bone, thus the remaining body of the astragalus is placed in such a position that it prevents an extreme flexion deformity. The remaining anterior edge is deeply resected into the niche, so that the ankle joint is actually in extreme equinus, while the subtalar joint and the entire foot are at a right angle to the line of the tibia.

*Congenital Amputation*—Dr. Henry Kessler, New York, New Jersey.

Dr. Kessler described the use of a kineplastic operation in congenital amputation. Instead of active motor fixation, canals are made in the stump and are attached to the kineplastic prosthesis. The active movement of the entire stump as a unit is utilized in place of the isolated muscle to produce action by the appliance. In this way his operation differs from the usual kineplastic operations of Sauerbruch, Bosch-Arana, and others.

*Amputation at the Knee Joint*—Dr. S. Perry Rogers, Chicago, Illinois.

The author advocated an amputation through the joint with fixation of the patella on the front of the femur in a dovetailed mortise. He claimed that this type of amputation offers three advantages: (1) a wider base for weight-bearing; (2) a bulbous end capable of sustaining the prosthesis without need of a shoulder strap; and (3) freedom from the danger of injury to the epiphyseal growth in children. The results obtained in twenty-two cases were discussed.

*Fractures of the Neck of the Femur in Children*—Dr. John C. Wilson, Los Angeles, California.

The very serious consequences which often follow fractures of the neck of the femur in children have not been sufficiently emphasized in the past. End-result studies show that in a large number of these cases aseptic necrosis of the head or associated deformities develop, even when immediate treatment has been carried out conscientiously. This leads one to a more serious consideration of the adequacy of accepted conservative measures and to the possible indications for operative interference, although the danger from nailing across the capital epiphyses must not be overlooked.

*Restoration of Function in Fractures of the Tibial Plateau Complicated by Injuries of the Semilunar Cartilage*—Dr. Guy M. Leadbetter and Dr. Frank M. Hand, Washington, D. C.

Injuries to the articular and semilunar cartilages, resulting from so-called "fender" fractures, were reviewed in a series of fifteen cases. The authors reached the conclusion that most of these fractures require open reduction. They advocated an approach from above, through the joint, in order to facilitate normal restoration of the plateau. The depressed fragments were "teased up", and, if necessary, the semilunar cartilage was removed. Some of the longitudinal type of fractures required metal transfixion. Physiotherapy was instituted after six weeks, and weight-bearing was allowed after about ninety days.

*The Restoration of Physiological and Anatomical Function in Old Ununited Intracapsular Fractures of the Neck of the Femur*—Dr. Edward L. Compere, Chicago, Illinois, and Dr. John Lee, Los Angeles, California (by invitation).

The method of treatment of old ununited intracapsular fractures of the femur which was presented in this paper includes open reduction, the use of an autogenous bone graft for the stimulation of osteogenesis, internal metal fixation, and immediate mobilization. No cast is needed. This enables the patient to be up in a wheel chair after one or two weeks, to be up on crutches after eighteen days, and to be discharged in an average of twenty-four days. Seven cases were reported, in six of which good results were obtained.

*Slipping of the Upper Femoral Epiphysis*—Dr. M. Beckett Howorth, New York, N. Y.

Dr. Howorth made a distinction between the complete and the incomplete slipping and emphasized the importance of early diagnosis of the preslipping stage. The aim of

treatment is the production of premature union by means of bone drilling and bone insertion by open methods. Early active motion after operation is essential. Of forty cases treated in this manner, the results were good in thirty-nine. Healing was obtained in thirty-seven in twelve weeks.

There were many interesting and well-presented scientific exhibits. The selection of the Committee on Scientific Awards was announced at the Annual Banquet on Wednesday evening. The Gold Medal was won by Dr. E. A. Codman, Dr. Channing C. Simmons, and Dr. Clifford C. Franseen for their exhibit on "Bone Tumors". The Silver Medal was awarded to Dr. Fuller Albright for his exhibit entitled "(A) Hyperparathyroidism, (B) Menopausal Osteoporosis, (C) Syndrome Characterized by Precocity in Females but not Males, Areas of Pigmentation, and a Disseminated Osteitis Fibrosa". The Bronze Medal was presented to Dr. Walter Bauer and Dr. Granville A. Bennett for their exhibit on "Degenerative Changes in Joints".

Certificates of Honorable Mention were awarded to the following:

Dr. Frank R. Ober, Dr. William T. Green, Dr. Leo J. McDermott, Dr. Sidney Farber, Dr. George Wyatt, and Dr. L. M. Strayer, Boston, Massachusetts:	Slipping of the Upper Femoral Epiphysis.
	Embryological Development of the Human Hip and Knee.
	Neuroblastoma.
Dr. Allan F. Voshell and Dr. Otto C. Brantigan, Baltimore, Maryland:	Internal Derangements of the Knee.
Dr. Walter P. Blount and Dr. Albert C. Schmidt, Milwaukee, Wisconsin:	Fractures in Children Are Different.
Dr. Edwin D. Weinberg, Baltimore, Maryland:	Syphilitic Bone and Joint Lesions.
Dr. Toufick Nicola, Montclair, New Jersey:	Types of Operations for Recurrent Dislocation of the Shoulder.
Dr. Emanuel B. Kaplan, Bronx, New York:	Injuries of the Extensor Tendons of the Fingers, Mechanism, and Repair.

At the Annual Banquet also, the report of the Membership Committee was presented, and the following were approved for membership:

Dr. Robert B. Acker, South Bend, Indiana.  
 Dr. Alexander L. Bassin, New Haven, Connecticut.  
 Dr. Gordon W. Batman, Indianapolis, Indiana.  
 Lieut.-Col. Oral B. Bolibaugh, San Francisco, California.  
 Dr. Hira E. Branch, Detroit, Michigan.  
 Dr. Alvia Brockway, Los Angeles, California.  
 Dr. Robert R. Brown, Nashville, Tennessee.  
 Dr. Philip I. Burack, Columbus, Ohio.  
 Lieut.-Col. Burgh S. Burnet, San Francisco, California.  
 Dr. Jack Kennedy Colman, Butte, Montana.  
 Dr. Alfred Ernest Deacon, Winnipeg, Manitoba, Canada.  
 Dr. George A. Duncan, Norfolk, Virginia.  
 Dr. George William Eggers, Galveston, Texas.  
 Dr. Charles F. Ferciot, Lincoln, Nebraska.  
 Dr. Paul J. Finegan, Trenton, New Jersey.  
 Dr. John J. Flanagan, Newark, New Jersey.  
 Dr. John W. Ghormley, Albany, New York.  
 Dr. Robert E. Hastings, Tucson, Arizona.  
 Dr. Robert G. Huckell, Edmonton, Alberta, Canada.  
 Dr. Archibald L. Huether, Salt Lake City, Utah.

Dr. A. Gurney Kimberley, Portland, Oregon.  
Dr. Joseph M. Murray, Ottawa, Ontario, Canada.  
Dr. Martin T. Myers, Atlanta, Georgia.  
Dr. Duncan C. McKeever, Houston, Texas.  
Dr. Robert Lee Patterson, Jr., New York, N. Y.  
Dr. John F. Pohl, Minneapolis, Minnesota.  
Dr. Richard B. Raney, Durham, North Carolina.  
Dr. Peter E. Sabatello, New York, N. Y.  
Dr. David I. Schwartz, Fort Wayne, Indiana.  
Lieut.-Col. Jesse Irving Sloat, Washington, D. C.  
Dr. Hugh Smith, Memphis, Tennessee.  
Dr. Irvin Stein, Philadelphia, Pennsylvania.  
Dr. José Ignacio Tarafa y Urdanivia, Habana, Cuba.  
Dr. Robert Ulin, Boston, Massachusetts.  
Dr. James B. Weaver, Kansas City, Missouri.  
Dr. Howard George Weiler, Wheeling, West Virginia.  
Dr. Royal Whitman was elected to Honorary Membership.

The officers for the ensuing year are:

President: Dr. Robert D. Schrock, Omaha, Nebraska.  
President-Elect: Dr. Oscar L. Miller, Charlotte, North Carolina.  
Vice-President: Dr. Paul B. Steele, Pittsburgh, Pennsylvania.  
Treasurer: Dr. E. Bishop Mumford, Indianapolis, Indiana.  
Secretary: Dr. Carl E. Badgley, Ann Arbor, Michigan.  
Librarian-Historian: Dr. Philip Lewin, Chicago, Illinois.

The following members of committees were also elected:

Membership Committee: Dr. Frederic C. Bost, San Francisco, California.  
Program Committee: Dr. Myron O. Henry, Minneapolis, Minnesota.  
Committee on Scientific Investigation: Dr. Charles W. Peabody, Detroit, Michigan.  
Committee on Legislation and Medical Economics: Dr. John R. Moore, Philadelphia, Pennsylvania.  
Nominees for American Board of Orthopaedic Surgery: Dr. Clarence Heyman, Cleveland, Ohio; Dr. Joseph A. Freiberg, Cincinnati, Ohio; Dr. Guy Caldwell, New Orleans, Louisiana.

The next meeting will be held in New Orleans, Louisiana, January 12 through 16, 1941.

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The Hospital for Joint Diseases of New York City announces the publication of the *Bulletin*, which will be devoted to recording material of orthopaedic interest from the experience of its clinical and laboratory divisions. For many years the staff physicians of the Hospital have been engaged in clinical investigation, research, and surgical studies of a wide variety of orthopaedic conditions. The *Bulletin* is intended as a vehicle for these experiences. It is edited by Dr. Samuel Kleinberg with the assistance of an Editorial Board.

# Current Literature

**FRACTURES AND OTHER BONE AND JOINT INJURIES.** R. Watson-Jones, B.Sc., M.Ch.Orth., F.R.C.S. Baltimore, The Williams & Wilkins Co., 1940. \$13.50.

This book of 723 pages gives a comprehensive review of injuries of bones and joints and methods of treatment. The text is well edited and amplified by numerous illustrations and drawings. In the presentation of the wealth of material, an honest enthusiasm is evident throughout. However, in connection with the optimism regarding results in certain troublesome fractures, it must be borne in mind that the author has practised under special conditions, which vary greatly from those in the United States.

One of the major themes which one meets throughout the book is that of adequate immobilization. The importance of this factor is stressed, as is that of avoiding unnecessary immobilization, which might result in stiffness of parts not concerned with the fracture. The subject of avascular bone necrosis is well presented, the salient points being emphasized by convincing illustrations.

The book covers such a wide field that it is not possible to mention each subject. Bone repair, delayed union and non-union, joint stiffness, soft-tissue injuries complicating fractures, and compound and infected fractures are all discussed in Part I. Pathological fractures and birth fractures comprise Part II. Part III covers injuries to the trunk and head, including spine, chest, and head. Parts IV and V take up injuries of the upper and lower limbs, while Part VI presents some unusual and instructive cases. The appendix contains a plan of organization of a fracture service. The index of authors and the general index furnish a comprehensive bibliography on the present-day treatment of fractures.

In general, the book contains much of value, which is well presented and adequately illustrated, but little that is new. The subject matter represents the experience of a large medical center in a foreign land. The physician interested in the treatment of fractures will find the book a desirable addition to his reference books upon the subject.

**FUSS UND BEIN: IHRE ERKRANKUNGEN UND DEREN BEHANDLUNG** (Foot and Leg: Their Diseases and Treatment). Prof. Dr. med. Georg Hohmann. 3 Aufl. Berlin, Julius Springer, 1939. 28.80 marks.

This is the third edition of a volume which first appeared in 1923, under the same title. While the general structure has been maintained, the book has been increased to over twice its original size. Many new illustrations have been added in the body of the work, rather than as a group at the end. The text is extremely rational and readable, although somewhat verbose.

About one third of the text is dedicated to an excellent discussion of flat-foot. Other conditions of the foot are treated in somewhat less detail. The thirty-fifth chapter bears the title "Significance of Foot Disabilities to State and Race". However, it contains only a very mild and abbreviated statement of the fact that foot disabilities may have social consequences in regard to military service, etc.

Except for a few topics, such as arthritis of the hip and knee, Osgood-Schlatter disease, hemangioma of the calf musculature, and compression bandage of the knee for effusion, very little is said of the leg or thigh to justify the inclusion of "leg" in the title. No ordered discussion of the deformities or therapy of the paralytic foot is given. There appears to be a lack of a guiding principle in the organization of the subjects which are considered. Nevertheless, those with a real interest in the commoner disabilities of the foot will find the book well worth having and reading. An extensive bibliography of

the German and French writers on the subject is appended. It is unfortunate, however, that the author does not appear to be as familiar with the literature which has appeared in the English language.

**OPERATIVE ORTHOPEDICS** Willis C. Campbell, M.D. St. Louis, The C. V. Mosby Co., 1939. \$12 50.

This is an excellent reference book of orthopaedic technical procedures. Almost every surgical procedure of modern times which has been described in the literature and which deals with problems of the spine or extremities has been mentioned or outlined in some detail.

The entire volume is exceedingly well written and well edited. The illustrations, which include roentgenograms, photographs, and artist's drawings, have been well chosen and reproduced in splendid detail. Techniques of operations have, for the most part, been shown by simple line drawings, which are easily followed.

The author does not clearly designate his own preference in the selection of a specific orthopaedic operation for each of the conditions described. Thus, in considering spine fusion, hip fusion, or the treatment of fractures of the neck of the femur, operative procedures and techniques used by many different surgeons are outlined. The younger and less experienced surgeon, who is attempting to determine what method he should adopt, may be confused by this fact. Presumably the neophyte will, in most instances, prefer the particular variation in technique which the author of the book has found most satisfactory. For this younger surgeon or student, however, a critical analysis of the advantages or the disadvantages of the varied techniques of operation for any specific condition would have been a real and much appreciated aid.

Some procedures have been described which, in the opinion of this reviewer, are definitely ill-advised or dangerous. Among these would be included the suggestion of drilling the neck of the femur and the capital epiphysis for the treatment of Legg-Calvé-Perthes disease, or the tibial tuberosity for the treatment of Osgood-Schlatter disease. The author does point out the fact that such trauma to epiphyseal growth centers of young children may result in serious deformities by the time these children have reached adult life, and warns against the indiscriminate use of such procedures.

This is one of the most complete reference books and, by and large, one of the best textbooks of orthopaedic surgical technique which has been published. No surgeon who is practising orthopaedic surgery as a specialty or who has a particular interest in fractures or traumatic surgery in general can afford to be without a copy of "Operative Orthopedics" in his library.

**DAS BRUSTBEIN UND SEINE GELENKE** NORMALE UND KRANKHAFT BEFUNDE, DARGESTELLT ZUM THEIL MITTELS NEUER RONTGENOLOGISCHER METHODEN. (The Sternum and Its Articulations Normal and Abnormal Conditions Demonstrated in Part by Means of a New Roentgenographic Method) Dr E. A. Zimmer. (Fortschritte auf dem Gebiete der Rontgenstrahlen, Ergänzungsband LVIII) Leipzig, Georg Thieme, 1939. 15 marks.

The author describes a method in which the roentgenograms are taken as double exposures,—that is, the roentgen-ray tube is moved a certain distance after the first picture has been taken. Then a second exposure is taken upon the same film. During this procedure, the patient, lying upon the film, is allowed to breathe. This method of double roentgenography has the advantage of the so-called "contact picture" by which the outlines of the ribs and lungs are obliterated.

The appearance of the sternum shows any variations of the bone nuclei,—that is, in their number, position, and time of emergence and blending. Nutrition is primarily furnished by the mammary artery. The injuries and diseases of the sternum are thoroughly discussed. Rickets, which often reveals grotesque deformities, is the first to be mentioned. Tuberculosis occurs primarily in the sternoclavicular joints. All the other

skeletal diseases, such as osteomyelitis, actinomycosis, and syphilis, involve the sternum and its joints. The sternoclavicular joints are often the seat of arthritis deformans. The aseptic necrosis which can be recognized by a dense focus surrounded by an atrophic area is well worth noting. The changes in tumors of the sternum are of especial interest. Extended metastases to the manubrium are repeatedly observed, particularly from hypernephroma, while primary tumors are rare.

These very informative papers by Dr. Zimmer, which contain numerous case histories with excellent roentgenograms, are a valuable contribution to our knowledge of the sternum and its diseases.

**ORTHOPEDIC OPERATIONS: INDICATIONS, TECHNIQUE, AND END RESULTS.** Arthur Steindler, M.D., F.A.C.S. Springfield, Illinois, Charles C. Thomas, 1940. \$9.00.

In this excellent textbook, the subject of orthopaedic operations is presented with a clarity of form and completeness of matter which leave almost nothing to be desired. The author modestly warns at the outset that "the whole truth cannot come from a solitary voice"; but the exhaustive lists of references at the conclusion of each chapter reveal the tremendous pains which he has taken to compare his opinions with other authorities in every aspect of his study. As a means of evaluating each surgical procedure, four critical principles are evoked: (1) Is the procedure rational from physiological and mechanical standpoints; (2) is it corroborated by experimental evidence; (3) is the technique consistent with such evidence and with empirical observations; and (4) do reliable end-result statistics substantiate its claims?

The introductory section of the text offers five chapters devoted to general principles: biology of functional repair, special risks, anaesthesia, preoperative and postoperative care, and consideration of surgical approaches. This is followed by a second section of twelve chapters, dealing with surgical technique as applied to the special tissues and structures of the locomotor system. Herein are included the specific operative treatments of tendons, joints, bones, ligaments, peripheral nerves, and skin. The final section reviews operative indications and end results of particular conditions. Congenital and traumatic deformities are discussed, together with such other topics as arthritis, degenerative bone diseases, circulatory diseases, tumors, and deformities due to disturbances of the nervous system, and inflammatory conditions.

Such a résumé of the contents can convey only an inadequate picture of the text itself. Its chief value lies in three particular characteristics, the first of which is its clarity. This may be derived in part from the illustrations, which are beautifully drawn and which explain more through semidiagrammatic figures than would have been possible with photographic views. These are combined with carefully worded descriptive paragraphs, which present essential anatomy and technique without confusing the reader with unimportant details. Secondly, the text offers a valuable running commentary upon the choice of various available procedures and upon the indications and applications of each. There is, by necessity, little space to extend such discussion beyond the minimum, but even this allows the inclusion of many suggestions and conclusions drawn from the author's wide experience. It seems unfortunate that technical descriptions of operations are often separated from the commentary upon them, which is reserved for chapters at the end of the book, but this defect is compensated by liberal cross references and an extensive index. Last of all, and perhaps most valuable, is the inclusive character of the text combined with its unbiased viewpoint. There is, perhaps, no specialty which offers the surgeon so many technical alternatives. The important variations and the principles justifying them are presented in these studies with the same force and clarity as the author's own methods. In a supplementary way, the list of references covering the choice of treatment for each condition extends the scope of this book far beyond the limitation of single authorship, and makes it in part a compendium and in part a bibliography. Altogether, the author has succeeded in presenting a clear, wise, and complete study of the principles and operative technique of orthopaedic surgery.



**PERIARTHRITIS HUMEROSCAPULARIS UND VERWANDTE ERKRANKUNGEN** (Periarthritis Humeroscapularis and Related Diseases). Dr. Felix Anger. (Beihefte zur Monatschrift für Unfallheilkunde und Versicherungsmedizin, Heft 28.) Berlin, Julius Springer, 1939. 4.50 marks.

A number of acute and chronic ailments of the shoulder joint and the surrounding structures are discussed. Among these are affections of bones and joints, muscles, ligaments, and bursae. Proper methods of examination for the various disabilities are described.

Among diseases of the soft parts are periarticular inflammation, degeneration of the supraspinatus tendon, bursitis, and calcification of ligaments.

The affections of bone and joint structures which are chiefly emphasized are osteochondritis dissecans, arthritis, and deforming disease of the acromioclavicular joint. A brief discussion of tuberculosis of the shoulder is included.

These subjects are discussed more completely from the standpoint of etiology, symptomatology, and diagnosis than from that of treatment.

**MASSAGE AND REMEDIAL EXERCISES IN MEDICAL AND SURGICAL CONDITIONS.** Noel M. Tidy. Ed. 4. Baltimore, Williams & Wilkins Co., 1939. \$5.25.

With an interval of but two years since the appearance of the third edition, this fourth edition shows few alterations or additions. This volume is of value to those, and only to those, who are familiar with and have had experience with the principles and application of physiotherapy. The author states in the preface that this book has been written to fill the need for a textbook for advanced students and those preparing for the examinations of the Chartered Society of Massage and Medical Gymnastics in England. The standard nomenclature in the Syllabus of this organization is used throughout the text. She further states that she has "tried to point out the general principles on which treatment should be based, leaving my readers to work these out in practise". Miss Tidy has covered the entire field of medicine and surgery in which she feels that this therapy will be of benefit. Chapters have been devoted to surgical conditions, fractures, dislocations, sprains, various deformities, and systemic and constitutional diseases.

Under each subject is given a brief statement on etiology, symptoms, and pathological changes, with an outline of the principles and methods of application of massage and exercise for this condition. Added notes, recommending the use of diathermy, short-wave therapy, and ultraviolet and infra-red radiation, have been inserted, but, as no information has been given concerning the technique of application and the benefits to be derived from the use of these modalities, the value of this addition is negligible.

In the chapters on fractures, dislocations, and sprains the very full notes cannot be followed explicitly by physiotherapists in the United States, as the methods of reduction and fixation, conditions, and recommended time for beginning physiotherapy are frequently at variance with the usually accepted methods in this country. A section on myositis ossificans has been added. This presents a clear picture of the causes and pathology, describes the symptoms so that there can be no excuse for overlooking the situation, and prescribes prophylactic treatment.

The section on medical conditions covers the variety of diagnoses found in an extensive general practice. Careful and thorough directions for massage and exercises are given for each condition. With war an actuality, Miss Tidy has found it advisable to add notes on gas poisoning and "to suggest treatment in accordance with the pathology of the lesions".

The tables of exercises show a thorough knowledge of the Swedish System, and they are clearly described, compactly arranged, and particularly well illustrated.

The author has evidently had an extensive experience in this special treatment, and she has presented exercises and movements which can be used successfully. This book should be a valuable guide to aid beginners in the adaptation of these modalities, and an interesting reference source for the experienced physiotherapist.

**DAS WIDERSTANDSVERMÖGEN DES FUSSES. EINE QUALITATIVE UNTERSUCHUNG UNTER BESONDERER BERÜCKSICHTIGUNG DER FUSSBEKLEIDUNG.** (The Ability of the Foot to Withstand Strain. A Qualitative Investigation with Special Regard to Footwear.) Dr.-Ing. Erhard Möhler. Berlin, Julius Springer, 1939. 6.90 marks.

After a detailed consideration of the anatomy of the foot, embellished with numerous mathematical formulae and diagrammatic representation, the writer demonstrates that it is the function and not the form of the foot which is really important to the individual. He enumerates the various structures and circumstances which tend to impair the function and discusses the shoes, exercises, and proper care of the foot which maintain its health. He offers the usual objections to poorly designed shoes and outlines his specifications for proper construction. He approves of the inclusion of the stock, built-in arch support, which he calls a "*Fusslager*", for the protection of the normal foot. For the treatment of feet which are already abnormal, he insists that arch supports be made to order, and these he calls "*Einlage*".

The monograph is largely of theoretical interest to American orthopaedic surgeons. The writer's fervent plea for cooperation between the manufacturer of shoes and those who must treat foot disorders would seem to be of greater significance in Germany than it is in the United States.

**ESGUINCE DE RODILLA (Injuries of the Knee).** Dr. Manuel Pérez Zabala. Buenos Aires, Sebastián de Amorrortu y Hijos, 1939.

There is no exact English equivalent of the Spanish word "*esguince*"; it means an injury to a joint by tearing or straining, which involves the ligaments, the soft structures, and sometimes the bone. It includes sprains, ruptured ligaments, subluxations, and dislocations.

The book is well organized as to its subject matter and very well written. The author describes the early recognition and treatment of these injuries by Hippocrates and Ambroise Paré and reviews the literature in connection with the whole subject. The sections on embryology and anatomy of the knee joint are especially good and are well illustrated. The mechanics of the knee joint itself are discussed in considerable detail, as well as the pathological anatomy in various conditions. Considerable space is given to the roentgenography of the knee joint, and the importance of taking roentgenograms from various angles and following the injection of air or oxygen into the joint is stressed.

The author recognizes three chief types of injury caused by tearing actions of the knee joint—hemarthrosis, injuries to the lateral and cruciate ligaments, and injuries to the menisci. There is a short discussion of hemarthrosis with some remarks on synovectomy. Almost one-half of the monograph consists of a discussion of injuries to the major ligaments of the knee joint. The mechanism of injury, the diagnosis, and the treatment are all very carefully considered and profusely illustrated. The author believes that the majority of tears of the internal or external lateral ligament of the knee may be cured by conservative treatment with a cast for eight weeks. In those cases in which the tear is complete and the ends of the ligament are wide apart or doubled back into the joint, the prognosis from conservative treatment is poor. After discussing several well-known operative techniques, the author describes his own method, which consists in reconstructing the ligament from fascia lata and anchoring it securely above and below the knee joint. The author states that in many cases of torn cruciate ligaments good results can be secured by conservative treatment in a cast. However, operation is often required, and several operative techniques are described.

Excellent drawings of all the operative techniques are shown, together with good roentgenographic reproductions and numerous case reports. At the end of the book there is a comprehensive bibliography. This is indeed an excellent monograph on the subject of "Injuries of the Knee".

VORLESUNGEN ÜBER FELDCHIRURGIE (Lecture on Field Surgery). Prof. Dr. med. Hermann Matti. Leipzig, Georg Thieme, 1939. 3 marks.

It is surprising how much material has been concentrated in the fifty-six pages of this monograph. All the important questions of field surgery have been given consideration. The author defines field surgery as war surgery with all the modifications necessitated by the tactics of the front line. In separate articles, based on a general review of the literature and on his experience in the World War, the author describes the mechanism of the wounds produced by firearms, the various types of infections, and the management of these infections and of wounds in general. Injuries to the extremities, gunshot wounds of joints, and trauma to peripheral nerves and vessels, as well as war injuries to the chest, abdomen, and face, are separately considered.

This monograph contains some valuable information and may stimulate further study of special interest to the military surgeon.

SHOCK. BLOOD STUDIES AS A GUIDE TO THERAPY. John Scudder, M.D., Med. Sc.D., F.A.C.S. Philadelphia, J. B. Lippincott Co., 1940.

According to the Foreword by Dr. Allen O. Whipple, this work is the outgrowth of generations of a family's experience with Asiatic cholera and other dehydrating diseases in India, and of the author's special studies in the United States of factors having to do with the maintenance of plasma volume.

The subject is taken up from the point of view of the historical development of knowledge concerning maintenance of the circulation, blood volume, plasma volume, plasma proteins, and plasma electrolytes. Particular emphasis is placed upon the usefulness of the falling-drop method of Barbour and Hamilton for determination of the specific gravity of whole blood and plasma. The importance of measurements of the blood potassium is also emphasized. The position is taken that shock is not due to potassium poisoning alone, but that alterations in potassium in both the blood and body fluids serve as a measure of profound cellular changes. Numerous case reports are cited in detail. Modern methods for preserving blood for transfusion are presented quite adequately. The methods for determining the specific gravity of the blood and plasma and the calculation of plasma proteins are given in detail. The bibliography contains 533 references.

The book is obviously the result of large experience and much thought and work. It is a pity that the rich subject matter is arranged in a manner which is extremely difficult to follow. If the reader wishes to learn about the significance of potassium changes in the blood, he must skip here and there throughout the whole book, and this is true of almost every subject which is considered. The book in this way resembles a note-book in which historical references, physiological phenomena, techniques, treatment, and case histories are jotted down as they come to mind. Perhaps the author was making an honest effort to have the reader draw his own conclusions, but he would have accomplished this purpose better by arranging his material in better form. Readers of this book will probably wish for more personal comment and simpler, more detailed explanations of the various complicated phenomena.

Nevertheless, the book should be valuable to surgeons and medical men who meet with various conditions of shock.

ERSTE HILFE BEI KIEFERBRÜCHEN UND SCHUSSBRÜCHEN (First Aid in Fractures of the Jaw and Gunshot Fractures). Prof. F. Proell. Leipzig, Georg Thieme, 1939. 1.60 marks.

This short monograph of thirty-one pages with sixteen illustrations is dedicated to the treatment of fractures of the jaw. The frequency and importance of these injuries in mechanized warfare are emphasized, and the emergency treatment is indicated. The monograph is apparently written for the busy military surgeon. The text is succinct and

clear and presents the subject of emergency treatment in a well-rounded form. A monograph of this type may ultimately contribute more to the treatment of gunshot fractures of the jaw than the more elaborate treatises on this subject.

**DIRECTORY OF MEDICAL SPECIALISTS CERTIFIED BY AMERICAN BOARDS—1939.** Paul Titus, M.D., Directing Editor. New York, Columbia University Press, 1940. \$5.00.

This official directory of more than 14,000 specialists certified by the American Boards has been compiled under the direction of the Advisory Board for Medical Specialties, which was organized in 1933 to coordinate graduate education and certification of medical specialties in the United States and Canada. Prior to 1939, each Board had published a separate register of its Diplomates. Since these lists appeared irregularly and were limited in distribution, the need was felt for a volume which would correlate and unify this information and make it more readily accessible to the lay public as well as to the medical public. This task has now been accomplished, and it is the present plan to issue revised editions of the Directory every two years.

Following the introduction and explanation of the abbreviations which have been used, the fourteen Boards are considered in alphabetical order. In the section devoted to each Board are included its history, personnel, purposes, and examination requirements, followed by a biographical list of Diplomates by State and City. The last section of the volume contains an alphabetical list of Diplomates of all the Boards, with their addresses and the names of the special Boards granting their certification.

The editors call attention to the fact that the omission of a man's name from any list does not necessarily mean that he is not qualified. Several of the Boards have only recently been organized, and the certification of many of the older and fully qualified men is still going on. Emphasis is also placed on the fact that these lists have been compiled regardless of race, creed, or any other personal considerations.

This Directory should be a valuable reference book for doctors, hospitals, medical societies, and libraries,—in fact, for anyone desiring information in regard to the qualifications of physicians in the various specialties.

**DIE ZWILLINGSPATHOLOGIE DES ANGEBORENEN KLUMPFUSSES. UNTERSUCHUNGEN AN EINER UNAUSGELESENEN ZWILLINGSSERIE VON 251 PAAREN.** (The Pathology of Congenital Club-Foot in Twins. Investigation of an Unselected Series of Twins Consisting of 251 Pairs.) Dr. Karlheinz Idelberger. (Beilageheft zur Zeitschrift für Orthopädie, Bd. LXIX.) Stuttgart, Ferdinand Enke, 1939. 8.60 marks.

The so-called mechanistic theory of the development of congenital club-foot has been again seriously shaken by proving the influence of heredity in part of the cases. The author is of the opinion that the question of heredity cannot be clarified sufficiently by the study of family histories alone, but must be completed by a study of twins. In an effort to solve this problem, he has painstakingly collected and sifted the vast number of cases of club-foot seen at the *Deutsche Krüppelfürsorge*.

From this study the author has drawn the following conclusions:

1. Typical congenital club-foot (the so-called "teratological" or "amniogenic" club-foot is not taken into consideration) is plainly an endogenous hereditary disease.
2. It is probably a simple recessive mild type of gene manifestation.
3. The peculiar ratio of two males to one female is probably caused by inhibition of the manifestation of modifying genes in the x-chromosomes.

It is, therefore, probable that congenital club-foot is an evidence of the simple recessive heredity. The large number of consanguineous marriages in the author's material makes the recessivity likely.

The long-buried mechanistic theory has been once more disproved by this publication. The results of this study are of great importance to those who are interested in hereditary diseases.

ÜBER DIE KNOCHENREGENERATORISCHE FÄHIGKEIT DES PERIOSTS (The Power of the Periosteum to Regenerate Bone). Gustav Levander. *Acta Chirurgica Scandinavica*, LXXXIII, 1, 1939.

Differences of opinion in the literature as to the power of the periosteum to regenerate bone in experimental animals depend largely upon differences in the ages of the animals at the time when the experiments are carried out. During the period of growth, the cambium layer is rich in cells which have the power of stimulating bone regeneration. After completed growth, this cellular inner layer disappears, and only the connective-tissue membrane remains. Periosteum-transplantation experiments in adult rabbits showed no bone formation. The writer doubts the claims of those who feel that new bone arises after periosteal grafting.

On isolated transplantation of periosteum in young animals new bone was obtained in the homotransplants as well as in the autotransplants in 33 per cent. and 25 per cent., respectively. Morphological analysis of the tissue reactions in these experiments showed that the grafted cell material dies in its new environment. The new bone develops out of the newly formed mesenchymal tissue at the seat of the grafting. The attempts at grafting bone tissue, including periosteum in young animals, showed similar results. The writer maintains that the greatly cellular mesenchymal layer of the periosteum stimulates bone regeneration in the same way as does the fully differentiated bone tissue.—

Walter P. Blount, M.D., Milwaukee, Wisconsin.

TUBERCULOUS SPONDYLITIS. A CLINICO-STATISTICAL STUDY. Thore Walheim. *Acta Chirurgica Scandinavica*, LXXXIII, 123, 1939.

On the basis of a study of 221 cases, treated over a period of seven years at St. Görans Hospital in Stockholm, the writer forms certain definite opinions. A long period of observation and conservative treatment is desirable before operation is performed. Fusion should be carried out only when the disease process is at a standstill. The writer recommends the method of Orell with the use of os purum and os novum to form a massive graft of the spinous processes of the affected vertebrae only. Recurrence was more common in the non-operated cases. Because of this and the writer's general impression that the patients who were operated upon did better, he advises arthrodesis of the affected vertebrae without reservation. A detailed statistical study is included.—Walter P. Blount, M.D., Milwaukee, Wisconsin.

STUDIES ON ROENTGENOGRAPHIC CHANGES IN BONES AS EARLY SIGN OF SCURVY IN INFANTS. P. W. Braestrup and Sv. A. Chrom. *Acta Paediatrica*, XXVII, 63, 1939.

Twenty-five children who showed a particularly low content of ascorbic acid in the blood plasma were carefully studied. The capillary resistance was also determined. The children varied in age between two and twenty-three months. There were six cases of rickets. The capillary resistance was lower than normal in seven cases. There was no definite evidence of scurvy in any of these cases. The authors conclude that roentgenographic examination is of no great assistance in the early diagnosis of scurvy.—

John G. Kuhns, M.D., Boston, Massachusetts.

SUR LA POLYARTHRITE AIGÜE COMME SYMPTÔME INITIAL DE L'INFECTION PRIMAIRE TUBERCULEUSE. J. Heimbeck. *Acta Paediatrica*, XXIV, 206, 1939.

Heimbeck reports the case of a girl of twenty-one, who had a non-tender swelling of both ankles without any other physical sign. The sedimentation rate was 15, and the intracutaneous tuberculin test was negative. There was pain in the knees, the left elbow, the right hip, and the joints of the fingers. In the course of a week all of the articular symptoms disappeared. There was gradual impairment in health, and, ten weeks later, both clinical and roentgenographic examinations first showed involvement of the right

side of the chest. No cutaneous allergy to tuberculosis was noted. Pleurisy developed, but six months later the patient was apparently well.

The author feels that "*rhumatisme tuberculeux primitif*", as described by Poncet, does not exist. He believes that tuberculous infection may be preceded by non-specific reactions. In erythema nodosum articular symptoms may develop in the evolution of tuberculous allergy. However, in the case reported, in which there was no development of allergy, there was a much rarer type of reaction to tuberculous infection.—*John G. Kuhns, M.D., Boston, Massachusetts.*

CONGENITAL SYNOSTOSIS OF THE CERVICOTHORACIC VERTEBRAE (The Klippel-Feil Syndrome). A. M. Rechtman and M. Thomas Horwitz. *The American Journal of Roentgenology and Radium Therapy*, XLIII, 66, Jan. 1940.

A comprehensive study of this malformation, together with the reports of three typical cases of the syndrome, is presented. About eighty-three articles on the subject were found in the literature. The syndrome is recognized clinically by: (1) a short, broad neck, the chin approximating or resting upon the sternum; (2) low implantation of the hairline; and (3) painless limitation of the motion of the head and the neck. It may be associated with scoliosis, Sprengel's elevation of the scapula, descent of the nipples of the breast, torticollis, and other congenital defects. Two of the authors' cases were complicated by neurological changes.

The main pathological finding is a fusion in whole or in part of two or more of the cervical vertebrae. A superior cervical spina bifida frequently exists. The thoracic cage is elevated with the formation of a cervical thorax which is more or less developed. The condition is easily identified roentgenographically.

Recognition of the syndrome seems important, because a good prognosis may be given provided that no other serious congenital malformation threatens the child's life. There is no therapy for the deformity *per se*. Associated deformities, such as scoliosis, torticollis, club-foot, etc., should be corrected.—*Richard C. Batt, M.D., Boston, Massachusetts.*

AN ANATOMICAL, PATHOLOGICAL AND ROENTGENOLOGICAL STUDY OF THE INTERVERTEBRAL JOINTS OF THE LUMBAR SPINE AND OF THE SACROILIAC JOINTS. Thomas Horwitz and R. Manges Smith. *The American Journal of Roentgenology and Radium Therapy*, XLIII, 173, Feb. 1940.

The authors state that the roentgenographic changes in the lumbar spine and pelvis must be interpreted and evaluated with care. Comparative anatomical, pathological, and roentgenographic studies of twenty-five human lumbar spines and pelvises suggested the existence of certain limitations in the value of the oblique projection. Reasons for these limitations were then investigated by means of anatomical and pathological observations on the apophyseal and zygapophyseal joints of the lumbar spine in 100 human cadavera.

Although every specimen in the first group was grossly normal, the 45-degree oblique roentgenograms strongly suggested pathological changes in 50 per cent. of the cases; in all of these specimens the angle of the zygapophyseal joint line, as measured from the sagittal plane, exceeded or was less than 45 degrees. Deceptive shadows were also produced by curvature and "tropism" (asymmetry) of the articular surfaces, as well as by advanced degenerative changes. To avoid these errors, the use of the 30-degree or 60-degree oblique view was suggested. However, in spite of careful roentgenographic examinations—including stereoroentgenograms—the diagnosis of sacro-iliac degenerative changes, especially ankylosis, was noticeably inaccurate and unreliable.

In confirmation of Hadley's work on subluxating facets, this study clearly showed how the intervertebral foramina decrease in size when the posterior part of the intervertebral disc is narrowed. With an intervertebral disc of normal height, however, these sub-

luxations may be simulated roentgenographically by bone proliferation in the articular margins of the facets.

The authors demonstrated several bone lesions that frequently do not show in the roentgenogram. Nuclear herniations into the vertebral bodies are not seen unless surrounded by osseous sclerosis. Accessory ossicles (epiphyses) at the tips of the articular facets are also frequently missed. These ossicles, when visualized, must be carefully differentiated from fractures of the facets.

These studies should be helpful to anyone interested in knowing the best positions for visualizing the facets in various parts of the spine.—*Richard C. Batt, M.D., Boston, Massachusetts.*

A CLASSIFICATION OF FOREARM FRACTURES NEAR THE WRIST. L. E. Snodgrass. *The American Journal of Surgery*, XLVI, 266, 1939.

This study of types of fractures and their variations is based on a review of roentgenograms of cases, tested with a circle drawn on the anteroposterior film. The center of the circle is the middle of the base of the ulnar styloid process and the circle is made by a compass passed through the middle of the articulation between the capitate and the proximal end of the second metacarpal. The circle is used as a simple device to show that the middle of the proximal end of the central unit of the hand is the same distance from the ulnar styloid process as the latter is from the point on the radius where the fracture line joins the lateral border of the bone. In suprastyloid fractures of the radius the distance from the center of the base of the ulnar styloid process to the second carpometacarpal articulation equals the distance from the base of the ulnar styloid process to the point where the fracture line joins the lateral surface of the radius.

The circle test is useful in differentiating typical from atypical fractures. The typical fracture sustained in a fall shows on the line or slightly distally but not proximally. The circle test also demonstrates that the suprastyloid fracture in children is governed by the same mechanism which produces the adult or Colles' type; and directs attention to growth changes in the distal ends of the radius and the ulna. It is also an aid in internal measurement based on anatomical landmarks.

The author concludes that the location of the fracture line on the distal end of the radius bears an unchanging relationship to the bones of the carpus, irrespective of the patient's age, and that epiphyseal separation on the distal end of the radius is the result of increased stress at the site during a certain age period and not of weakness of the epiphyseal line.—*Custis Lee Hall, M.D., Washington, D. C.*

ACROMIOCLAVICULAR AND STERNOCLAVICULAR JOINT INJURIES. Nelson J. Howard. *The American Journal of Surgery*, XLVI, 284, 1939.

After describing the anatomical instability of these two joints, the author classifies the injuries as sprains, incomplete subluxations, and complete dislocations. The importance of lateral as well as anteroposterior roentgenograms in showing backward dislocations of the clavicle is stressed. Conservative treatment—adequate reduction followed by a modification of the brachioclavicular sling—is used in most cases. In sternoclavicular dislocations, which are more rare, reduction is maintained by the clavicular cross. Surgical repair by various methods is discussed, and results in thirty-four cases of all types are shown. Campos, of Brazil, has a series of cases in which operative repair of old unreduced dislocations was carried out with excellent results, and this operation should prove a valuable contribution toward cure of these injuries.—*Custis Lee Hall, M.D., Washington, D. C.*

TREATMENT OF DELAYED OR NON-UNION BY BONE DRILLING. Stanley M. Leydig. *The American Journal of Surgery*, XLVI, 300, 1939.

Study of a series of 330 cases of fractures of the tibia, seen in 1937, disclosed eight

cases of delayed union or potential non-union. No systemic or local causes for the non-union were found except poor approximation, remanipulation, or compound injuries. The use of a skintight cast and a walking caliper is discussed. No grafts or metal plates were used, and the fragments were drilled by the method suggested by Beck, of Killana, which has been described by Böhler. In all eight cases the fragments united solidly.—

*Custis Lee Hall, M.D., Washington, D. C.*

**EXTERNAL LATERAL DISLOCATION OF THE ELBOW.** W. D. Griesemer. *The American Journal of Surgery*, XLVII, 57, Jan. 1940.

Six cases of this rather rare type of elbow injury are recorded by the author in a very well-presented and well-illustrated article. The mechanical factors producing the condition are described and the importance of soft-part injuries, complications of wrist injuries, and proper use of the roentgenograms are discussed. The author stresses the difficulties which are encountered when the fracture-dislocation involves the epitrochlea and states that, if closed reduction fails, open operative methods should be resorted to at once. Active motion, with the arm supported in a splint, should be started early.—*Custis Lee Hall, M.D., Washington, D. C.*

**THE USE OF ANTISEPTICS IN THE TREATMENT OF OPEN WOUNDS.** W. L. Estes, Jr. *The American Journal of Surgery*, XLVII, 369, Feb. 1940.

Treatment of an open wound should be started as soon as possible after injury. It should comprise: (1) control of bleeding and protection of the wound; (2) cleansing and sterilization of the skin around the wound; (3) protection of the skin around the wound with sterile covers; (4) cleansing of the wound (débridement); (5) drainage, closure, and splinting. Débridement should be done gently to prevent damage to healthy tissue; however, it must be thorough.

Antiseptics are of value in skin disinfection, but are seldom necessary in the wound itself, and their indiscriminate use may interfere with normal repair. An antiseptic is recommended as an added safeguard in soil-contaminated wounds. Dakin's solution may be used. An ideal antiseptic in open wounds should possess effective bactericidal action, should be non-toxic, and should not interfere with or delay healing.—*O. Anderson Engh, M.D., Washington, D. C.*

**PRIMARY CLOSURE OF TRAUMATIC WOUNDS WITH ESPECIAL REFERENCE TO THE CONVERSION OF COMPOUND INTO SIMPLE FRACTURES.** John E. Cannaday. *The American Journal of Surgery*, XLVII, 375, Feb. 1940.

Dr. Cannaday advocates the early closure of compound-fracture wounds. The advantages of this method are: First, the patient is saved a prolonged period of hospitalization as well as the pain and inconvenience of frequent dressings; second, the injured limb is left with more normal skin, rather than with a large area of scar tissue with low vitality; third, the loss of time and expense of care can be kept down to a reasonable minimum. The technique consists essentially of thorough cleansing of the surrounding skin, complete débridement after protection of the wound and, when possible, immediate reduction of the fracture.

The views and methods of numerous surgeons are contained in the article.—*O. Anderson Engh, M.D., Washington, D. C.*

**THE MISUSE OF SKELETAL TRACTION.** Carleton Mathewson, Jr. *The American Journal of Surgery*, XLVII, 408, Feb. 1940.

The history of skeletal traction is reviewed. In the present enthusiasm over the procedure, many complications have resulted. These are due to misuse.

The greatest danger of the method is infection, which may result from improper



surgical technique at the time of application, or from subsequent motion of the metal agent used. To prevent motion in the longitudinal axis, a method is described. A traction pin which passes through an area of hematoma or a linear fracture associated with the major fractures makes the possibility of infection greater. Improperly placed pins result in inefficient traction and severe damage to bones, soft tissues, epiphyses, and joints. Metal tongs are condemned. Distraction results in non-union and delayed union. Multiple insertion and ambulatory treatment, in which pins incorporated in plaster are employed, are dangerous.—O. Anderson Engh, M D., Washington, D C

A SIMPLE EFFECTIVE METHOD FOR THE TREATMENT OF FRACTURES OF THE UPPER TWO-THIRDS OF THE HUMERUS. FLAVEL B. GIRD. *The American Journal of Surgery*, XLVII, 113, Feb. 1940

Dr. Gurd describes a method, not original, which has proved satisfactory in almost all cases of fracture of the upper two-thirds of the humerus including and below the surgical neck. It consists in the application of an axillary pad, so placed as to give slight abduction and to permit the upper forearm to be levered downward when a sling is applied to the wrist area. A molded cast prevents motion in any direction. The weight of the forearm, plus the leverage, reduces the fracture. It has the following advantages: It permits ambulatory treatment, it is convenient and economical, and it yields a high percentage of good results.—O. Anderson Engh, M D., Washington, D C

THE PROBLEM OF THE UNUNIONED FRACTURE. MELVIN S. HENDERSON. *The American Journal of Surgery*, XLVII, 151, Feb. 1940

These fractures may be considered under two headings: (1) delayed union and (2) non-union. It is important to recognize the division between the two groups. Systemic factors play but a small part, as a rule. The local, mechanical relationships are important. Conservative measures may succeed in stimulating metabolism at the fracture site in cases of non-union, but in such cases operative measures are necessary. The onlay graft is recommended. It should be a large graft and should be firmly clamped to the fragments. Operation should not be undertaken in the presence of draining sinuses or inflammation.

In femoral-neck fractures the insertion of a large piece of autogenous bone, such as a fibular segment, is described. When fibrous union is present, grafting can be done by "blind" insertion, but, when no fibrous union is present, the open operation is required. The troublesome sites of fracture and the preferred methods of treatment in these regions are discussed. Fractures of the lower humerus are the most difficult. The onlay graft is used in these cases.—O. Anderson Engh, M D., Washington, D C

SIMPLE ANTERIOR DISLOCATION OF THE ELBOW JOINT WITH RUPTURE OF THE BRACHIAL ARTERY. CASE REPORT. JAMES A. JACKSON. *The American Journal of Surgery*, XLVII, 479, Feb. 1940.

This condition is very rare. The absence of radial pulse and change in color of the hand should make one suspect it. Immediate diagnosis and surgical interference are necessary to save the extremity. The author anastomosed the artery, using a venous cuff for reinforcement. An excellent result was obtained, except for some restriction in extension of the elbow.—O. Anderson Engh, M D., Washington, D C.

EXPERIMENTAL FAT EMBOLISM. J. DEWEY BISGARD AND CHARLES BAKER. *The American Journal of Surgery*, XLVII, 466, Feb. 1940.

Injured bone is the principal source of fat embolism because of the presence of free fluid fat and of non-collapsible open veins and the accumulation of fat under pressure.

In the experiments, which were conducted with rabbits, marrow fat was used, and the authors drew the following conclusions:

1. Ether anaesthesia has little or no beneficial influence upon embolization of fat.
2. The use of a tourniquet during operations upon bone and gradual release, with some venous bleeding before complete release, may lessen the incidence of immediate fat embolism.
3. The prevention of increased pressure by drainage of the medullary canal and wound is probably one of the most important measures.
4. Manipulation of injured bone should be gentle and minimal.
5. Immobilization and elevation reduce the chance of fat embolization.—O. Anderson Engh, M.D., Washington, D. C.

PRIMARY REPAIR OF SEVERED TENDONS. THE USE OF STAINLESS STEEL WIRE. Sterling Bunnell. *The American Journal of Surgery*, XLVII, 502, Feb. 1940.

Primary suture of tendons should not be done except under strict indications of time factor, condition of wound, hospital facilities, and special training of surgeon. Otherwise, it is better to repair them later, débriding and closing the wound and covering vulnerable parts. A delay of six months is necessary, if there has been infection of bone. Repairing within a sheath is the most difficult. Trauma should be minimal, and the tendon stitch should be simple and of non-irritating material. The author suggests the use of fine stainless-steel wire. The manner of insertion and of removal are described. Stainless-steel wire is non-irritating, and, from the author's description, it should be of considerable value in tendon suture.—O. Anderson Engh, M.D., Washington, D. C.

KNEE INJURIES INCIDENTAL TO SPORTS AND RECREATION. Augustus Thorndike, Jr. *The American Journal of Surgery*, XLVII, 542, Feb. 1940.

The author feels that too little attention has been devoted to trauma incident to sports and recreation. Adequate treatment, promptly administered, has been found to be very beneficial. The immediate application of cold and a compression bandage, followed by rest, control hemorrhage and protect the injured tissues. All former strains should be protected by adhesive strapping to prevent a recurrence in such sports or recreation where stress and strain are expected.

Ligament sprains and joint contusions predominated in almost 500 cases at Harvard University. Trauma to the median collateral ligament was the commonest single injury. The use of sponge rubber in a compression bandage is illustrated. A steady decline in the ratio of serious internal derangements is proof of the value of protection to previously sprained knees.—O. Anderson Engh, M.D., Washington, D. C.

MENISCO EXTERNO DE RODILLA DISCOIDEO (Discoid Lateral Meniscus of the Knee). Oscar R. Marottoli. *Anales de Cirugia*, V, 217, 1939.

The author reports two cases of discoid lateral meniscus. The first case was that of a boy, twenty-two years old, who, two months before examination, had injured his knee while playing football. Since that time there had been pain in the joint, swelling, and, on one occasion, a typical blocking of the knee. At operation a comma-shaped meniscus was found; this was much broader than usual, with a partial tear through its back portion. The other case was that of a girl, twenty years of age, who, three months before examination, had sustained a blow on the knee with the knee in flexion. There had never been any actual blocking, but the patient had experienced pain and discomfort in the knee and, on several occasions, she had had a sensation of partial blocking and sudden releasing of the knee. Operation revealed a typical discoid meniscus, which covered the entire outer half of the surface of the joint.

The author is of the opinion that this lesion is a rather common finding in connection

with injuries of the lateral meniscus. Cases of discoid meniscus are of two types: (1) congenital, in which symptoms come on either shortly after birth or during infancy; and (2) traumatic, in which the patient has no symptoms until an injury occurs. The two cases reported belong in the latter category. The author calls attention to a very important diagnostic symptom which is commonly found in cases of discoid meniscus,—namely, a so-called springing knee. The patient with this symptom can extend the knee easily to a certain point and then encounters a feeling of resistance, this suddenly disappears, and the knee quickly goes into complete extension.—*Louis W. Breck, M D, El Paso, Texas.*

BEITRAG ZUR MARMOCKNOCHENKRANKHEIT (ALBERS-SCHONBERG). [A Contribution to Marble-Bone Disease (Albers-Schonberg)] A. Albrecht und O. Geiser. *Annales Paediatrici*, CLIII, 81, 1939.

The authors report two cases of the malignant infantile form of marble-bone disease in first cousins,—a girl of fifteen months and a boy of seven and one-half years. In the latter case the parents were blood relations. Both patients showed severe sclerosing changes in the skeleton, hydrocephalus, optic atrophy, and marked anaemia. The younger child presented evidences of extramedullary blood regeneration with enlargement of the liver and the spleen.

The clinical picture, the outstanding feature of which was the bone change, and the differential diagnosis are discussed. It is noted that the infantile form of the disease can be distinguished from the benign adult form. Both forms never occur in the same family. Harnapp's classification of this entity is rejected. He divided the disease into three types as follows: (1) the severe early infantile form, characterized by ease of bone fracture, severe anaemia, hydrocephalus, and optic atrophy, (2) a form of later years, distinguished by ease of bone fracture and moderate or absent anaemia, and (3) a benign form, characterized only by a diffuse osteosclerosis in the normal consistency of bone.

The differential diagnosis of the infantile form does not offer any difficulties. The adult form must be differentiated from the cases of osteosclerosis following primary diseases of the blood,—for example, the leukaemias.

The pathological changes mentioned in the literature and the results of metabolic investigations, as well as the theoretical conceptions of the disease, are briefly discussed.—

*A. I. Bleden, M D, Iowa City, Iowa*

UNTERARMBRUCHE (Fractures of the Forearm) Hans Kotrnetz. *Archiv fur orthopadische und Unfall-Chirurgie*, XXXVIII, 673, 1938.

The author has compiled the results of treatment of fractures of the forearm in the second surgical *Universitätsklinik* in Vienna, considering the material in two divisions,—fractures in the young and fractures in adults. The methods of Bohler have been regularly employed.

#### *Fractures in the Young*

One hundred and eight cases of fracture in the distal third of the radius were treated. Only those with more than 15 degrees of angulation were subjected to reposition. An average immobilization period of twenty-seven days in short arm plaster casts was employed. In three cases, the bone refractured after removal of the plaster at the end of three weeks.

Twenty-four cases of fracture in the middle and proximal thirds of the radius were treated, twenty-one were subjected to reduction. The average immobilization period, mainly in long arm plaster casts, was forty-three days. One patient had circulatory difficulties, despite early splitting of the plaster. There were two cases of refracture, in spite of long fixation.

Eleven cases of isolated fracture of the ulna were treated by immobilization in long arm plaster casts for an average of thirty-one days. In two cases the bone refractured.

after four weeks in plaster. One case in which healing had occurred with considerable lateral displacement of one fragment was reviewed five years after fracture. No sign of displacement or of the fracture site was demonstrable.

Sixty-eight cases of *greenstick fractures of both bones in the distal third* were treated in both short and long arm plaster casts. An average immobilization period of twenty-four days in plaster was employed. In fifty-seven cases reduction was required; in four of these the fracture had to be reduced again in from ten to fourteen days and the bone refractured because of malposition four weeks later. The results were uniformly good except for loss of 20 degrees of supination in one case and some slight axial deformities (less than 15 degrees); in two cases the bone refractured after plaster removal.

One hundred and eleven cases of *subperiosteal or greenstick fractures in the middle and proximal thirds of both bones* were treated. The average immobilization period in a long arm plaster was forty-eight days. In three cases there was a residual mild angulation and in one case a loss of 30 degrees of supination. Otherwise the end results were excellent. Striking was the finding of fourteen cases of circulatory disturbance requiring splitting of plaster. In four of these cases the bone refractured. In two cases with skin punctures healing occurred without complication.

Thirty-six cases of *distal-third fractures of both bones with lateral displacement* were treated by immobilization in plaster for an average of forty-six days. In eight cases temporary circulatory disturbances were noted. A slight radial angulation resulted in four, and in one case there was a 20-degree loss of supination.

Of forty cases of *fractures of both bones in the middle and proximal thirds with lateral displacement*, thirty-seven were treated by closed reduction, and three required the use of operative methods (double-wire traction in two cases and a Lane plate in one). The average immobilization period in long plaster casts was fifty-seven days. The end results were good. Only five patients showed a slight dorsal angulation and only three a loss of 20 degrees of supination. There were four temporary circulatory disturbances and three refractures.

In these 398 fractures in the young, treated by the unpadded plaster cast, the results were excellent. The author explains the cases of circulatory disturbance as being due to the development of a second hematoma during the manually produced fracture of the remaining cortex in correction of greenstick deformities. He believes delaying reduction for twenty-four hours will help in greenstick lesions, but that early reduction will aid most in lesions with lateral displacement.

#### *Fractures in Adults*

Of thirty-four *fractures in the middle and proximal thirds of the radius* in adults, twenty-six required reduction, and one came to open reduction. Of six cases of circulatory disturbance, one which was untreated for four days ended disastrously. All were treated simply in long arm plaster casts. The hand was fixed in supination for proximal-third fractures and in mid-position for distal-third fractures. The results were good.

In twenty-four *ulnar-shaft fractures* union was obtained after an average of fifty-eight days in long arm plaster casts. Only five showed any displacement.

Of thirty *fractures of the shafts of both bones*, seventeen were treated in long arm plaster casts after fixation; eight, by double-wire fixation; and five, by open operation. Aside from cosmetic inferiority of the cast-treated cases, the results statistically seem as good as in those treated by wire extension.—Joseph E. Milgram, M.D., Brooklyn, New York.

ZUR KLINIK UND RÖNTGENOLOGIE DER ATYPISCHEN CHONDRODYSTROPHISCHEN WACHSTUMSSTÖRUNGEN (Clinical and Roentgenographic Findings in Atypical Chondrodystrophic Growth Disturbances). Wolfgang Marquardt. *Archiv für orthopädische und Unfall-Chirurgie*, XXXVIII, 711, 1938.

The author presents seven cases of growth disturbances. The first three cases he

In the former, there are three fractures: shaft, head, and tubercle. All grades of displacement may occur. He emphasizes that the abduction fracture is more impacted and is easily displaced, and that secondary dislocations are hard to handle. For this reason, it is dangerous to try to treat these patients in abduction. It is not safe to try to obtain craniocaudal roentgenograms. Instead of such a view, he recommends a transscapular view with the superior ray following the course of the body of the scapula from in back forward, the plate being held against the front of the shoulder. The abduction splint is quite unsatisfactory, and the patient is best treated by simple bandaging of the arm to the body. His practice is to commence motion after three weeks in the Desault bandage.

The dorsiduction fracture frequently requires reduction. Once reduction is obtained manually under general or local anaesthesia, fixation in a bandage is again the most satisfactory form of treatment. He emphasizes that repeated attempts at reposition during the course of the first two or three weeks always result in damage. Of sixty-six patients with abduction fractures, fifty-four obtained complete function in fifteen weeks. Of sixty-eight patients with dorsiduction fractures, fifty-two obtained full restoration of function in fourteen weeks.

Occasionally in bad fractures, the author advises removal of the head fragments through the smallest possible operative exposure. Extirpation of the head should be specifically reserved for cases where methods of reduction are not applicable. Failure of reduction or poor reduction results in disturbance of function. The author suggests that the general health suffers as a result of such trauma.—*Joseph E. Milgram, M.D., Brooklyn, New York.*

BEITRAG ZUR KASUISTIK DER SEITLICHEN KNIEGELENKSLUXATION (Contribution to the Collected Cases of Lateral Dislocation of the Knee). Hermann Ehlert. *Archiv für orthopädische und Unfall-Chirurgie*, XXXIX, 646, 1939.

This case report concerns a complete lateral dislocation of the knee, which was sustained by a male, twenty-six years old, while skiing. Closed manual reduction was performed by simple traction under anaesthesia. Aspiration was done the next day and fifty cubic centimeters of blood was withdrawn. The knee was fixed on a Volkman splint. Motion was started in eleven days, and in eight weeks the patient was discharged with a range of motion of 180 to 85 degrees. When reexamined eleven months after the accident, there was a range of motion of 180 to 50 degrees. There was slight instability on passive testing, if his muscles were voluntarily relaxed, but not otherwise. The patient became slightly fatigued on excessive walking, but the function of the knee was excellent.—*Joseph E. Milgram, M.D., Brooklyn, New York.*

RISSBRUCH AM FERSENBEINHÖCKER (Avulsion Fracture of the Os Calcis). Victor Struppler. *Archiv für orthopädische und Unfall-Chirurgie*, XXXIX, 651, 1939.

The author reports in detail the findings in a case of avulsion fracture of the tuberosity of the os calcis due to the action of the tendo achillis. He performed an open reduction of the displaced fragment, and transfixed it with a percutaneous nail. A plaster cast was used until union took place. The nail was removed in six and one-half weeks.

He disagrees with the concept of Böhler, who minimizes the rôle of the calf muscles in the production of the lesion. The author points out that, while it is true that the upper edge of the os calcis is covered with cartilage and is separated from the tendo achillis by a bursa, yet the tendon inserts into the greater part of the back of the os calcis. Most lesions occur through the sites of its attachment. Study of the density of the os calcis indicates weak, thin trabeculae above the insertion of the tendo achillis and denser bone in the zones of tendon attachment.—*Joseph E. Milgram, M.D., Brooklyn, New York.*

**PROTRUDED INTERVERTEBRAL DISK. REPORT OF A CASE; NOTE ON A POSSIBLE INFLAMMATORY ETIOLOGIC FACTOR (CIRCUMSCRIBED ARACHNOIDITIS).** Gilbert C. Anderson and Erwin Wexberg. *Archives of Surgery*, XXXIX, 952, Dec. 1939.

The authors present their findings in a case of intervertebral-disc protrusion from the lumbar spine, adding another explanation for the pressure phenomenon productive of the syndrome usually attributed to the displaced herniated meniscus.

The patient presented a protrusion of the fourth intervertebral disc. Associated with this there was a cyst in the meninges, apparently produced by mechanical irritation of the displaced disc. In the light of the operative findings it would appear that the pre-operative roentgenographic interpretations were based on the existence of the cyst rather than the displacement of the disc.

This presentation leaves one with the conclusion that the mere operative finding of a displaced disc is not sufficient, but that one must look for adjacent irritative phenomena, which, although secondary to displacement of the disc, may be the immediate etiological factor in the production of the symptoms.—*I. William Nachlas, M.D., Baltimore, Maryland.*

**EFFECTS OF ESTROGEN ON BONES, JOINTS AND LIGAMENTS OF CASTRATED GUINEA PIGS.**

Charles J. Suto and Leo Pomerantz. *Archives of Surgery*, XXXIX, 992, Dec. 1939.

To test the effect of estrogen on the skeletal system, twelve castrated male guinea pigs were given injections of the hormone, and the effects on the tissues of the symphysis pubis and sacro-iliac joints, as well as the capsular tissue of the major joints, were studied. The only change attributable to the injections was found in the symphysis pubis. Here the authors noted a thickening of the ligaments, particularly of the posterior ligaments, associated at times with secondary degeneration in the hypercellular material. The interpubic cartilages were similarly affected. In the sacro-iliac joints no change was observed.—*I. William Nachlas, M.D., Baltimore, Maryland.*

**THE CARPUS, WITH REFERENCE TO THE FRACTURED NAVICULAR BONE.** Edwin French Cave. *Archives of Surgery*, XL, 54, Jan. 1940.

The much discussed subject of non-union of fractures of the carpal navicular is subjected to a careful study based chiefly on an examination of the patients seen and treated at the Massachusetts General Hospital. After a review of the development of the carpus, the anatomical considerations are described with particular reference to the blood supply of the navicular. The effects produced by the interruption of the blood supply when the bone is fractured are described, and the theories for the development of the non-union are presented and evaluated. The clinical factors are then discussed and, under the head of "treatment", it is emphasized that in fresh fractures adequate prolonged immobilization can be expected to yield a well-healed bone. In the patient who presents himself with an old ununited fracture which cannot be expected to unite by conservative measures, it was found that a satisfactory healing could be obtained by the insertion of an autogenous dowel graft into a drill hole made through the fragments. One gets the impression that the excision of the fractured navicular either *in toto* or in part does not yield a satisfactory wrist.—*I. William Nachlas, M.D., Baltimore, Maryland.*

**PLASTICA LIBERA CON RIBALTAMENTO DEL TETTO COTILOIDEO (Free Plastic with Turning Down of the Ledge of the Acetabulum).** D. Bargellini. *Archivio di Ortopedia*, LV, 3, 1939.

The author reviews twenty-seven cases in which shelving operations were performed. For young children with a thin covering of soft tissues, he uses a straight incision from the anterior superior iliac spine to the greater trochanter; otherwise the Smith-Petersen incision is employed. In bringing down the rim of the acetabulum, he regards as particularly important a good adaptation of the upper ledge toward the head of the

femur. For that purpose he measures on the roentgenogram the angle between the head of the femur and the roof of the acetabulum. The tibial graft which he inserts above the rim should be wedge-shaped, and the wedge should have exactly the same angle as the measured angle.—*Josef Wolf, M.D., Davenport, Iowa.*

SCAFOIDE BIPARTITO E SCAFOIDE ACCESSORIO DEL CARPO (Bipartite Navicular and Accessory Navicular of the Wrist). Alberto Vaghi. *Archivio di Ortopedia*, LV, 50, 1939.

The author describes a case of bipartite navicular of both wrists. On the left side the roentgenogram showed, just before the styloid process of the radius, a third bone which has not been mentioned in the literature. Of the two possibilities of regarding this bone as an accessory bone or of assuming a tripartite navicular, the author chooses the former.—*Josef Wolf, M.D., Davenport, Iowa.*

LA FRATTURA ISOLATA DEL DENTE DELL'EPISTROFEO (Isolated Fracture of the Odontoid Process of the Axis). M. Molteni. *Archivio di Ortopedia*, LV, 55, 1939.

Six cases of isolated fracture of the odontoid process of the axis are reviewed. In two cases the fracture was associated with an anterior subluxation of the atlas. While the diagnosis can be made only from the roentgenographic evidence, the characteristic symptoms—immediate pain, tenderness by pressure on the posterior pharynx, a hematoma at the posterior wall of the pharynx, or neurological disturbances of the occipital nerve—lead to the diagnosis. Reduction is indicated if, in addition to the axis, there are other vertebrae fractured, if there is marked deformity, or if there is a paralysis of the muscles of the neck. For reduction under local anaesthesia the Roger Anderson spinal-traction splint is recommended. Immobilization should be maintained for at least six months.—*Josef Wolf, M.D., Davenport, Iowa.*

LA SOSTITUZIONE PERONEALE DELLA TIBIA (Substitution of the Fibula for the Tibia).

F. Mandruzzato. *Archivio di Ortopedia*, LV, 99, 1939.

Four cases of total or partial absence of the tibia—congenital, as the result of osteomyelitis, or following resection for tumor—in which the defect was filled with the fibula, are described. In addition to the reported cases, the author used the same operative technique in eleven more cases of absence of the tibia.

The technique in children is the same as in adults. In congenital absence of the tibia, the author operates early, since in his cases the transplanted fibula grew considerably under the influence of weight-bearing. If there is only partial absence of the tibia, and if the upper or lower epiphysis or both epiphyses are present, it is important not to destroy the epiphysis in preparing the bed for the fibula. If there is a deformity, it should be corrected before the transplantation. When dissecting the fibula, one should avoid any injury to the peroneal nerve under the head of the fibula. The diaphysis of the fibula should not be freed too extensively from the surrounding soft tissues, and especial care should be taken not to injure the nutritional artery. The implantation of the fibula in an upper or lower tibial fragment should be as firm as possible, so that early weight-bearing may be possible. In cases of osteomyelitis, only a perfectly healthy fibula should be transplanted, and no signs of infection should be present in the tibial bed.—*Josef Wolf, M.D., Davenport, Iowa.*

SOPRA NOVE CASI DI IPOPLASIA CONGENITA FEMORALE (Nine Cases of Congenital Hypoplasia of the Femur). L. Longhi e F. Zanuso. *Archivio di Ortopedia*, LV, 321, 1939.

From the abundant material of the Orthopaedic Clinic of the University of Milan, the authors collected during the decade of 1929 to 1939 nine cases of congenital deficiency of the femur. They classify the cases as follows:

1. Malformation and shortening of the diaphysis.

2. Malformation in the upper and lower epiphyseal and metaphyseal regions with coxa vara.
3. Deficiencies of the femur with total or partial lack of differentiation of the hip or knee joint or both.
4. Total absence of the femur.

In a conspicuously high percentage of cases the deficiency of the femur was associated with other congenital anomalies. In three cases congenital dislocation of the hip was present on the same side and in three more on the opposite side; in three other cases there was hypoplasia of the acetabulum. In five cases the patella was absent. In three cases there was complete absence of the fibula, and in one case partial deficiency of the tibia was present. In two cases several rows of bones of the foot were absent. In one child, two and one-half years old, the roentgenogram of the femur did not show a nucleus of the head. As to the etiology, the authors are more inclined toward the theory of arrested development of the embryonic germinal plasma than to that of an external cause.—*Josef Wolf, M.D., Davenport, Iowa.*

SULLA DIAFISECTOMIA NELLE OSTEOMIELITI (Diaphysectomy in Osteomyelitis). A. Albanese. *Archivio di Ortopedia*, LV, 370, 1939.

The first "*resectio diaphysaria*" for osteomyelitis was performed in Italy almost one hundred years ago, in 1845, by Larghi. Since that time opinion, as reflected in the literature, has changed repeatedly with regard to the indications for and the technique of the operation.

As to the indications, the author excludes the hyperseptic type of case in which the resection would probably not save the member and the life of the patient would be endangered. Furthermore, the operation is not suited to the subacute and chronic cases in which the periosteum shows so much degeneration that osteogenesis is not likely. It should be reserved for the acute and subacute cases in which the local process shows little tendency toward healing or has a tendency to spread. In order to determine the right time for the intervention, the author advocates repeated roentgenograms at short intervals. He prefers to leave the wound open after resection. He has abandoned the lavage with antiseptic solutions, which are not only useless but they also damage the periosteum and may destroy the regeneration of that tissue. In the after-treatment it is important to use plaster casts, splints, or other orthopaedic appliances for a long time to prevent secondary deformities.—*Josef Wolf, M.D., Davenport, Iowa.*

CONTRIBUTO ALLA TECNICA DELL'ARIDUZIONE INCRUENTA DELLA LUSSAZIONE TRANS-NAVICULOPERILUNARE (Contribution to the Technique of the Bloodless Reduction of the Transnavicular-Perilunate Dislocation). F. Vecchione. *Archivio di Ortopedia*, LV, 389, 1939.

A new method of reduction of retrolunate dislocation of the wrist is described. With the patient under general anaesthesia, an assistant holds the arm for countertraction with the elbow flexed at an angle of 90 degrees and the forearm in pronation. The operator, who is seated, grips with his right hand the three middle fingers of the dislocated hand and makes steady traction on the medial axis of the forearm with a few degrees' deviation to the ulnar side. At the same time, the operator places his left thumb on the dorsal side over the capitate and his index and middle fingers on the volar side upon the anterior border of the distal end of the radius and the lunate. The traction is continued for ten minutes, interrupted by light movements of flexion and extension to mobilize the lunate. By this manoeuvre the capitate is distracted as much as possible from the dorsal side of the radius. After the preliminary movement the hand is brought into extension at an angle of 40 degrees, while the traction and the pressure against the lunate and the anterior volar border of the radius are continued. The next step is volar flexion with dorsal pressure upon the capitate, which then will slip toward the concave surface of the lunate.



The wrist is immobilized in 20 degrees of volar flexion for eight weeks. Even in old cases with fracture of the navicular and median-nerve paralysis good results are obtained by this method.—*Josef Wolf, M.D., Davenport, Iowa.*

TRAUMATISMOS OBSTETRICOS DA REGIÃO ESCAPULO HUMERAL (Obstetrical Injuries of the Shoulder). Domingos Define e Ivo D. Frascá. *Arquivos Brasileiros de Cirurgia e Ortopedia*, VI, 58, 1938.

After reviewing the concepts of various authors since Duchenne in regard to these obstetrical injuries, the author supports Putti's ideas and adopts his classification. He shows that it is difficult to make the differential diagnosis between paralysis and obstetrical trauma in a newborn child. Based on Scaglietti's findings, he discusses the question both from the clinical and from the roentgenological point of view. He does not consider displacement of the epiphysis as a characteristic sign. Treatment depends on the age of the patient and the seriousness of the existing torsion. In patients under two years of age, treatment should be conservative; in patients over that age, it should be operative. The author concludes that, in addition to Sever's operation, it is necessary to perform Putti's rotation osteotomy in order to correct any existing retroversion of the epiphysis. He believes that in most cases an average rotation of 40 degrees is sufficient. After osteotomy, he feels that it is well to carry the arm in the intermediate position.—*Dr. Azzi Leal, São Paulo, Brazil.*

OSTEOTOMIAS SUB-TROCANTERIANAS (Subtrochanteric Osteotomies). Barros Lima. *Arquivos Brasileiros de Cirurgia e Ortopedia*, VI, 97, 1938.

The author discusses the indications for and the mechanics of subtrochanteric osteotomy. He explains its importance in the correction of abnormal posture produced by ankylosis of the hip joint. In some cases, arthrodesis—particularly of the extra-articular type—is also necessary. He states that, following operation, the limb should be placed in a position of slight flexion and moderate abduction.

In cases of old unreduced congenital dislocation of the hip the author believes that subtrochanteric osteotomy not only provides better support but also allows better function of the pelvitrochanteric muscles. With Pauwels, he advocates subtrochanteric osteotomy in the treatment of fractures of the neck of the femur and of coxa vara.—*Dr. Azzi Leal, São Paulo, Brazil.*

PARALISIA ISQUEMICA DE VOLKMANN (Volkmann's Ischaemic Paralysis). F. E. Godoy Moreira. *Arquivos Brasileiros de Cirurgia e Ortopedia*, VI, 289, 1938.

The author presents a very interesting amputation specimen, consisting of an upper limb of a seven-year-old child with a greenstick fracture of both forearm bones. Improper treatment with two very constricting wooden splints caused ischaemic paralysis, which produced an arterial lesion with thrombosis. Amputation was done upon the onset of gangrene. Careful dissection of the specimen showed the thrombus obstructing the humeral artery just above its bifurcation. The other anatomical structures were normal, and there was no subaponeurotic hematoma.—*Dr. Azzi Leal, São Paulo, Brazil.*

TRATAMENTO DAS FRATURAS NO TORNOZELO (Treatment of Fractures of the Ankle). Orlando Pinto de Souza. *Arquivos Brasileiros de Cirurgia e Ortopedia*, VI, 321, 1938.

The author states that the subject may be considered practically closed to discussion of a general order. After a historical enumeration of the characteristics of these lesions, he quotes the classifications adopted by various authors and groups them in three categories: (1) those in which the name of the surgeon is attached to the type described; (2) those based on the mechanism of production; and (3) those based on the anatomical and physiological findings.

The author is in favor of the manipulative treatment and he quotes statistics to point out the advantages of the manipulative methods over open operation. Limiting the indications for open operation to the cases in which manipulative procedures fail, he states that in such cases it is necessary to treat all the fragments which present displacements. In discussing the various aspects of manipulative treatment of these fractures, he defends the ambulatory method, which he feels shortens the time of treatment. He bases his assertions not only on statistical data but also on personal observation of cases. He believes that skeletal traction has a very limited use in the treatment of fractures of the ankle.—*Dr. Azzi Leal, São Paulo, Brazil.*

**MODIFICAÇÃO DE ESTATICA NO TRATAMENTO DE PARALISIAS TOTAIS DOS MEMBROS INFERIORES NA DOENÇA DE HEINE-MEDIN** (Modifications of the Statics in the Treatment of Total Paralysis of the Lower Limbs in Heine-Medin Disease). Paulo Zander. *Arquivos Brasileiros de Cirurgia e Ortopedia*, VI, 445, 1938.

After pointing out the necessity of always correcting contraction deformities, the author reviews the types of apparatus used for complete paralysis of the lower limbs. He states that those types are to be preferred which are based on mechanical principles similar to those employed in the making of artificial limbs. He enumerates these principles and stresses the necessity of knowing them in cases of amputation and paralysis and of applying them in orthopaedic surgery. Several cases are presented in which arthrodesis, arthroereisis, and osteotomy were performed according to these principles.—*Dr. Azzi Leal, São Paulo, Brazil.*

**LUXAÇÕES HABITUAIS DO OMBRO** (Recurrent Dislocations of the Shoulder). F. E. Godoy Moreira. *Arquivos Brasileiros de Cirurgia e Ortopedia*, VI, 509, 1938.

The author reviews the etiology of the condition and calls attention to the fact that in recent years great importance has been attached to skeletal injuries as a direct cause of dislocations. He stresses the frequency of dislocation of the shoulder in athletes and epileptics. The influence of age and sex are also considered. The author concludes that the most important factors are previous malformations and trauma. The anatomy and pathology of the lesions are next discussed, and the author accepts Nicola's classification of bone, capsule, and muscle lesions. Several methods of treatment are mentioned, but the author prefers Oudard's operation. Two cases are reported in which the author performed Oudard's operation, as modified by Basy and Wilmoth, with excellent results.—*Dr. Azzi Leal, São Paulo, Brazil.*

**LUXAÇÃO PATOLÓGICA DA COXO-FEMURAL** (Pathological Dislocation of the Hip Joint). Jorge Glasner. *Arquivos Brasileiros de Cirurgia e Ortopedia*, VII, 101, 1939.

Eight cases of pathological dislocation of the hip joint were studied by the author at the Clinic of Prof. Barros Lima in Recife. Of these, six were due to coxalgia; one, to osteomyelitis; and one, to acute suppurative arthritis. The author reviews the etiology, pathology, clinical examinations, diagnosis, treatment, prognosis, and prophylaxis in these cases and makes the following observations:

1. All cases were in children, ranging in age between eleven months and eleven years.
2. By means of the roentgen-ray it was possible to verify the presence of the articular focus.
3. The dislocation was always upward and backward.
4. In five of the cases the dislocation was spontaneous; in the others, the trauma itself was insufficient to produce it.
5. The chief object of the treatment should be the reduction of the dislocation and the avoidance of its recurrence.

6. As regards treatment, the manipulative procedures with continuous traction are the most indicated.

7. Prophylaxis must be kept in mind in the treatment of the cases which are due to arthritis.—*Dr. Azzi Leal, São Paulo, Brazil.*

**MECHANICAL PRINCIPLES IN THE CAUSATION AND TREATMENT OF DISEASE.** Fay Maclure. *The Australian and New Zealand Journal of Surgery*, IX, 66, 1939.

The author discusses the mechanics of circulation in relation to various pathological affections of the extremities, dealing particularly with conditions of stasis and congestion. "The outflow of circulating fluid in the body is commenced by cardiac contraction and thrust, and is carried on by distension and elastic recoil of arterial walls as far as the capillary network. The return flow through venous and lymphatic channels is brought about by several factors: (1) Valves which assist the onward and prevent the backward movement of fluid in vessels, (2) Gravity which hastens or retards flow according to the direction in which this force acts, (3) Muscles whose alternate contraction and relaxation contribute largely to the maintenance of circulation, (4) Latent energy contained in cardiac thrust and arterial distension which is transformed into a force acting on returning fluid. This transformation of energy is dependent on (5) limiting layers of resistant membranes, such as skin, aponeurosis, fibrous sheaths and capsules."

*Veins and Lymphatics:* Lymph and venous vessels resemble one another in many ways. Both have a similar function, are lined by similar endothelium, and are provided with valves. The author believes that many conditions attributed to venous obstruction are in reality due to lymphatic stasis.

*Valves:* Incompetence of venous valves gives rise to varix. The author points out the resemblance of saphenous varicosity to other external herniae and suggests that this clinical entity be named saphenous varix, directing attention to the mechanism of its production.

*Muscle Movements:* Muscle movements promote return circulation in three ways: (1) Their increased metabolic rate demands a greater blood supply, causing an increased *vis a tergo* of the arterial system; (2) they have a pump-like effect on the veins and lymphatics; and (3) they create pressure on the surrounding tissues, resulting in an elastic recoil which stimulates circulation. Hence, the maintenance of muscle function is important in fractured extremities.

*Gravity:* Gravity may assist or obstruct venous and lymphatic return circulation, according to the direction of the flow. This simple principle is involved in the treatment of chronic leg ulcer, in which the best method of cure is by absolutely continuous elevation. Gravity is frequently misused in the treatment of infections of the hands or fingers, where the surgeon neglects to insist on elevation.

*Acute Inflammation and Chronic Ulcer:* Acute inflammation is characterized by greatly increased circulatory activity. Its treatment requires rest, and the natural forces will bring about repair. In chronic ulcer, on the other hand, the opposite picture is present with diminished blood supply, venous stasis, and oedema. Antiseptics have no value in the treatment of this condition, which will respond only to mechanical stimulants to venous and lymphatic circulation, such as gravity, muscle movement, and elastic pressure.

*Elasticity and Tone:* Normal tissue is resilient and elastic, offering a recoil to changes in tension, which converts the latent energy of arterial pressure and thrust into a force that pumps lymph and venous fluid out of the part. When tissue has become atonic from disease or disuse, external elastic pressure should be applied and muscle activity encouraged until tone is recovered.

*Limiting and Enveloping Membranes:* The mechanics of circulation in an extremity can remain intact only as long as the limiting membrane, the endothelium, is preserved. When this is broken, circulation remains disturbed until epithelium is restored or an efficient substitute is applied to offer a resistant cover to the tissues, having the same

mechanical effect as the epithelial layer. This may be accomplished by producing a surface film through cauterizing the protein of the superficial layer of granulating tissue, but is best done by the use of elastic pressure. Elastic compression bandages are recommended in the treatment of chronic ulcers; they offer a simple means of overcoming stasis, and promote rapid healing.

*Skin Grafts:* Successful skin grafts depend on the use of continuous elastic pressure to prevent local stasis and oedema. This should be employed before and during grafting, as well as postoperatively to pump the field free of venous and lymphatic fluid.—*Daniel H. Leunthal, M.D., Chicago, Illinois.*

#### ACTINOMYCOTIC AND MYCOTIC LESIONS, WITH SPECIAL REFERENCE TO 'MADURA FOOT'.

B. P. Tribedi and B. N. Mukherjee. *The British Journal of Surgery*, XXVII, 256, 1939.

Thirty-two cases of actinomycosis have been collected from the Calcutta Medical College. Twenty-three of these infections involved the foot. A brief history with clinical and pathological descriptions of the lesions is given for three recent patients, in all of whom amputation was done.

"Mycetoma", "Madura foot", "Maduramycosis", and "Madurosis" are the usual names given to this type of infection. It is commonly found in workers in the soil of tropical countries where shoes are not worn.

Two of the cases cited had actinomycotic infections and the third was mycotic in nature. The mode of infection, bacteriology, morbid anatomy, and histology of the three cases are discussed.—*Ernest M. Daland, M.D., Boston, Massachusetts.*

#### FRACTURES OF THE LOWER LEG A METHOD OF REDUCTION AND IMMOBILIZATION.

D. Lang Stevenson. *The British Journal of Surgery*, XXVII, 390, 1939

The patient is placed on an operating table with both lower legs hanging over the end of the table. A Kirschner wire is passed through the calcaneum and a Kirschner "horse-shoe" is attached. To the latter are attached two steel hooks, which, in turn, are fastened by a swivel joint to a board on the floor. The table is gradually raised to give countertraction. The surgeon sits before the apparatus and manipulates the fracture, using the patient's other leg to check the position. Plaster is then employed to maintain the correction accomplished. Reduction is checked roentgenographically before the plaster is applied.—*Ernest M. Daland, M.D., Boston, Massachusetts*

#### NOTES ON A SUCCESSFUL CASE OF KRUKENBERG'S OPERATION Thomas Puice. *The British Journal of Surgery*, XXVII, 419, 1939

A male native of South Rhodesia sustained a severe laceration of the hand by being mauled by a leopard. Amputation was done at the wrist joint. Two weeks later the forearm was split up for a length of eight inches. The tendons and muscles were separated into two groups, and the tendons were stitched to the periosteum and over the ends of the bones. The raw areas were covered with full-thickness grafts. This gave a forceps with which the patient can hold a knife, fork, hammer, or bottle. The radius appears to move against a fixed ulna.—*Ernest M. Daland, M.D., Boston, Massachusetts.*

#### WAR WOUNDS AND AIR RAID CASUALTIES COMMON INFECTIONS OF WOUNDS: TETANUS AND GAS GANGRENE. Claude Frankau *British Medical Journal*, I, 989, 1939.

Every wound produced by a missile is potentially an infected one. Simple perforating wounds may heal by first intention, but this outcome is rare. The low incidence of tetanus in the last War, after antitetanic serum had been given every wounded man, shows that the disease is preventable. Even the most trivial wound may be the cause of

death. The customary prophylactic dose for the majority of wounds is 500 U.S.A. units. The period of incubation in cases in which serum has not been given may vary from twelve hours to twenty-eight days. The onset usually occurs in from seven to ten days. If symptoms begin within seven days, a fatal result is almost inevitable. In some cases local tetanus may appear,—that is, a localized stiffness and spasm of muscles in the neighborhood of the wound. Large doses of serum are then instituted, and generalized symptoms do not occur. Very large doses should be given as follows: On the first day, (1) intrathecally, (2) intramuscularly, (3) subcutaneously, and (4) intravenously,—15,000 U.S.A. units being administered by each route. This dosage, with the exception of the intravenous dose, should be repeated daily until symptoms begin to abate. The intense spasms are best controlled with avertin. Experiences in the past War showed that in patients who had received a prophylactic dose of serum the mortality from tetanus was 50 per cent., while in unprotected cases it was nearer 80 per cent.

The average time of onset of gas gangrene is about thirty-six hours after the receipt of the wound. In the author's opinion, prophylaxis by means of antigas-gangrene serum is of little value. The best form of prophylaxis is early and careful débridement of the wound. In massive gangrene of the limb, with damage to the main artery, early amputation is essential. In cases where a muscle or a group of muscles is attacked, resection of the infected area often cuts the infection short and saves both limb and life.—*James W. Tourney, M.D., Boston, Massachusetts.*

#### WAR WOUNDS AND AIR RAID CASUALTIES. GUNSHOT WOUNDS OF THE UPPER EXTREMITIES. Claude Frankau. *British Medical Journal*, I, 1189, 1939.

In the treatment of these wounds several points are important. First, excision of the track may be very difficult because of important structures located in a small space; this can be overcome to a certain extent by free skin incisions. Second, bone fragments can be more freely removed in fractures of the shaft of the humerus, as shortening of the upper limb is of no great importance. Third, nerve lesions are more common in the upper extremities and are of greater importance. Fourth, a more conservative attitude toward amputation can be held in the upper extremity. There is remarkably little difficulty after removal of large portions of the clavicle. In fractures of the shaft of the humerus a Thomas splint is generally used for transport to the base hospital. Elbow-joint fractures are commonly of a severe nature with much trauma to the bone, which is often associated with nerve-trunk injuries. Ankylosis, or greatly restricted movement, is almost inevitable. Therefore, the arm must be put in the most useful position at as early a date as possible. A primary amputation of the hand should be carried out only where tendons, vessels, and nerves have been completely destroyed.—*James W. Tourney, M.D., Boston, Massachusetts.*

#### WAR WOUNDS AND AIR RAID CASUALTIES. INJURIES OF THE LOWER LIMB. St. J. D. Buxton. *British Medical Journal*, I, 1241, 1939.

General principles of treatment became established during the last War. The most important principle was that of early operative treatment. Hence, if possible, the important surgery is done at the casualty clearing station rather than at the base hospital. Immobilization of a badly damaged limb is an important factor in limiting shock. This is best achieved by the early application of a Thomas splint. Primary excision and suture of wounds are seldom applicable to the lower limbs. Such a procedure is not recommended if more than six hours have elapsed since the injury. After twenty-four hours, large incisions, with the removal of foreign bodies, particularly in muscle, will lead to an aggravation of the local and general signs, and usually to septicaemia. Hemostasis is important, and extravasated blood should be removed. In larger wounds Carrel's tubes are inserted. The removal of bone fragments which are loose or nearly so is important. If wounds are seen in the inflammatory period, surgical intervention should be minimal,

tuberculosis. The differentiation between a solitary tuberculous cavity and a Brodie's abscess may be difficult from clinical and roentgenographic examinations. Peripheral sclerosis may be present surrounding a tuberculous lesion. Tuberculous cavities may heal by reossification, while some cases clinically healed may show persistent cavities roentgenographically.—*Daniel H. Levinthal, M.D., Chicago, Illinois.*

LE TRAITEMENT DE LA COXA VARA ESSENTIELLE DES ADOLESCENTS (The Treatment of Essential Coxa Vara of Adolescence). C. P. Van Nes. *Bulletin de la Société Belge d'Orthopédie et de Chirurgie de l'Appareil Moteur*, XI, Jan. 1939.

The author does not advise *redressement forcé* in cases of progressive slipped epiphysis. It is indicated only in cases of acute slipping, which is equivalent to a fracture of the femoral neck. Whenever possible, he performs an osteosynthesis with the Smith-Petersen nail. In old cases he uses subtrochanteric or transtrochanteric osteotomy.—*Robert Soeur, M.D., Brussels, Belgium.*

LE TRAITEMENT PREVENTIF DE LA COXALGIE DANS LES LÉSIONS JUXTA-ARTICULAIRES DE LA HANCHE (Preventive Treatment of Tuberculous Arthritis in Juxta-Articular Lesions of the Hip). A. Richard. *Bulletin de la Société Belge d'Orthopédie et de Chirurgie de l'Appareil Moteur*, XI, Mar. 1939.

The author advocates surgical intervention in tuberculous juxta-articular lesions. If the lesion is near the elbow, the ankle, or the knee, he often obtains good results, but, if it is near the hip, the results are bad.

Of eleven cases which he had observed and in which curettage was done, a serious coxalgia developed after operation in ten. When the focus is not operated upon, the resulting tuberculous arthritis is more benign.—*Robert Soeur, M.D., Brussels, Belgium.*

THE TREATMENT OF PAGET'S DISEASE BY ADRENAL CORTICAL PREPARATIONS. E. M. Watson. *The Canadian Medical Association Journal*, XLI, 561, 1939.

The origin of adrenal therapy in this condition is uncertain, but in 1928 Walton found that the injection of either fresh or dried whole adrenal glands eased the pain of typical Paget's disease. The author states that the excessive phosphatase content of the blood must be regarded as an effect rather than the cause. He believes it to be due to a diffusion of the enzyme from the sites of formation in the bones at rates above the normal.

Nine patients with Paget's disease were treated with extract of adrenal cortex (cortin). They were given from five to ten cubic centimeters or more intramuscularly each week. In all nine patients there was a more or less marked reduction of the serum phosphatase, and in six there was a diminution of pain. A satisfactory explanation for the results is not apparent, and whether or not the treatment is effective in checking the progress of the disease is undecided. Injections of a synthetic cortical hormone (desoxycorticosterone acetate) and the oral administration of desiccated adrenal cortical extract were less effective than the injection of a cortical extract in solution. Atrophy of the adrenal glands following prolonged administration of cortin to persons without cortical hypofunction is regarded as a possibility.—*F. R. Wilkinson, M.D., Toronto, Ontario, Canada.*

A NEW APPROACH TO THE KNEE JOINT. Victor O. Mader. *The Canadian Medical Association Journal*, XLII, 17, Jan. 1940.

"An ideal approach to the knee joint is one which (1) will give good exposure and permit thorough exploration of all parts of the joint; (2) will be adaptable to any operation which the pathological lesion indicates; (3) will result in no disability; and (4) will permit of a short convalescent period. . . . Mr. R. Brooke has reported thirty cases of

removal of the patella for fracture with excellent functional results." Stimulated by this report and by the observations of Prof. Whitnall of Bristol, the author was led to the belief that a more direct and adequate exposure of the knee joint could be made through the quadriceps and patellar tendons after the patella had been removed. He first carried out operations on twenty fresh cadavera to demonstrate that the procedure was anatomically sound and to assure himself of its advantages. He then used the approach in cases in which resection was contemplated and in a case of internal derangement in which wide exploration of the joint was necessary.

The patient is placed in the supine position with the knees flexed over the end of the table. A curved infrapatellar incision is made, and the patella and quadriceps extensor tendon are exposed. The tendon overlying the patella is split longitudinally, and the incision is carried upward into the quadriceps tendon and downward into the patellar tendon. The patella is dissected out. The joint is thus exposed, and retraction gives an excellent view.—*F. R. Wilkinson, M D, Toronto, Ontario, Canada.*

**POTASSIUM CHLORATE IN THE TREATMENT OF POLIOMYELITIS.** Jean Saucier and Oscar W. Stewart. *The Canadian Medical Association Journal*, XLII, 19, Jan. 1940.

During an epidemic of poliomyelitis in Switzerland in 1936 and 1937, Contat treated thirty-five cases and recorded the curative effect of potassium chlorate given in the pre-paralytic and early paralytic stages. During an epidemic in which the general mortality rate was 20 per cent., he reported no deaths and only two instances of residual paralysis among his thirty-five patients. With the aid of Arthus, Spycher, and Debat he carried out experiments on monkeys, which seemed to give striking confirmation to his clinical impressions.

Saucier and Stewart felt that a detailed repetition of these experiments was warranted. Twelve monkeys were inoculated with the virus of poliomyelitis. Potassium chlorate, given orally in doses of ten and twenty centigrams per kilogram of body weight per twenty-four hours, failed to protect or favorably to influence the course of the disease in monkeys (*Macacus rhesus*) inoculated with the several strains of poliomyelitis virus used in their experiments.

It is interesting that in this number of the *Journal* a fatal case of accidental poisoning by potassium chlorate is reported.—*F. R. Wilkinson, M D, Toronto, Ontario, Canada.*

**COMPRESSION FRACTURES OF THE VERTEBRAL BODIES FOLLOWING INDUCED AND "IDIO-PATHIC" CONVULSIONS.** George E. Reed and Travis E. Dancey. *The Canadian Medical Association Journal*, XLII, 38, Jan. 1940

Clinical and roentgenographic studies were carried out on seventy-two patients, all known epileptics. Lateral roentgenograms of the thoracic spine showed compression deformities of the vertebral bodies in 34.2 per cent of the cases. Sixty-eight patients who had had one or more convulsions with either insulin or metrazol showed compression fractures of the bodies of one or more thoracic vertebrae in 31.4 per cent. It was noted that these fractures involved particularly the vertebral bodies of the mid-thoracic portion of the spine and that usually more than one vertebral body was affected.—*F. R. Wilkinson, M.D., Toronto, Ontario, Canada.*

**ACUTE HAEMATOGENOUS OSTEOMYELITIS.** R. Hall McCoy and D. E. Ross. *The Canadian Medical Association Journal*, XLII, 162, Feb. 1940

Eighteen cases of acute hematogenous osteomyelitis in children are reported. These cases are divided into three groups. Group I, those cases without a positive blood culture, consisted of five patients; there were no deaths. *Staphylococcus pyogenes* was grown from the pus found at operation. Group II, those cases having a maximum growth of not more than eight colonies per cubic centimeter of blood comprised two pa-

tients; there were no deaths. Again staphylococcus pyogenes was the organism isolated. Group III, those cases showing a culture exceeding eight colonies per cubic centimeter of blood, consisted of eleven patients; there were nine deaths. In three cases streptococcus haemolyticus and in eight cases staphylococcus pyogenes were isolated.

The type of local treatment varied from simple incision and drainage of the soft-tissue abscess to more radical opening of the bone, followed by various irrigations, diaphysectomy, and, finally, the treatment as outlined by Orr. All patients with positive blood cultures were treated with staphylococcus antitoxin. It is recommended that the antitoxin be diluted with normal saline and given as a continuous intravenous drip.

The authors' chief conclusions are:

1. Surgical drainage is essential in the treatment of acute hematogenous osteomyelitis of the long bones and is not contra-indicated in cases of severe septicaemia. It is best accomplished by the Orr method.

2. Repeated transfusions and intravenous administration of fluid are of value.

3. Staphylococcus antitoxin does not appear of value as regards the formation of secondary abscesses and the final fatal outcome. In some cases it seems to cause a temporary improvement.

4. A reduction in the mortality rate of acute hematogenous osteomyelitis with septicaemia cannot be accomplished until a more effective treatment for the septicaemia is available.—*F. R. Wilkinson, M.D., Toronto, Ontario, Canada.*

ANCA A SCATTO (Snapping Hip). F. E. Godoy Moreira. *La Chirurgia degli Organi di Movimento*, XXIV, 381, 1939.

The author reports a case of habitual snapping hip of six years' duration in an athlete, twenty-one years old, which was apparently caused by a hooking of the posterior portion of the fascia lata, the so-called "tractus cristotibialis" of zur Verth, over an abnormally large superior margin of the greater trochanter. The treatment consisted in surgical resection of the prominence of the trochanter and a fibrous mass arising from the fascia lata opposite the trochanter, which was probably becoming arrested over the trochanter and giving rise to symptoms. The result, six years later, was excellent.

The author classifies snapping hips as: (1) periarticular and (2) intra-articular. The former may be voluntary and semihabitual without pain or involuntary and habitual with associated pain. In this type the tensor fasciae latae or the anterior margin of the gluteus maximus snaps over the greater trochanter. The intra-articular type consists in a subluxation of the hip, is usually habitual, and is associated with lesions of the posterior margin of the acetabulum.—*A. W. Ciani, M.D., Iowa City, Iowa.*

UN CASO INTERESANTE DE OSTEOARTRITIS TÍFICA DE LA CADERA (An Interesting Case of Typhoid Osteo-Arthritis of the Hip). Ulises Sosa de Quesada. *Cirugía Ortopédica y Traumatología*, VII, 27, 1939.

Following a detailed survey of the history of subtrochanteric osteotomy of the femur, the author discusses the indications for and the advantages of the various types.

An interesting and rare case of typhoid arthritis of the hip joint is presented. The patient had typhoid fever fifteen months before the time of his operation. Three months after the onset of the fever, a severe acute inflammatory condition of the hip developed, which was very painful, and eventually the joint was aspirated. Sinuses formed, drained for some months, and finally closed. The patient was left with a slight adduction deformity and a painful and almost useless hip. When admitted for operation, he was using two crutches and getting about with some difficulty. A modification of the Schanz osteotomy was performed, although it was done rather high. The patient was placed in a cast for ten weeks and then allowed up. The end result, eleven months after operation, was very good; the patient walked without crutches and with a hardly noticeable limp.



1. Black and half-breed children seem less liable to be affected by the disease.
2. In most of the cases the preparalytic symptoms were referable to gastro-intestinal disturbances.
3. The majority of the patients were between one and two years of age.
4. No significant sex differences could be established.
5. The lower limbs were involved more often than the upper, but there was no difference in regard to the right or the left side. The muscles most frequently affected were: in the upper extremity, the deltoid, the biceps, and the triceps; in the lower extremity, the tibialis anterior, the quadriceps, and the gluteus maximus.
6. The pain, sensation of cold, and sweating in the extremities disappeared following ultra short-wave diathermy.
7. An excess of galvanic current did more damage than good.
8. In those cases in which treatment was interrupted, even for only a short time, there was either a stationary phase or impairment in the activation of muscle function.
9. Muscle exercises under water were of the utmost importance in reestablishing muscle function.
10. There were no cases of lateral deviation of the patella following transplantation of a single tendon behind the patella to overcome quadriceps paralysis, and active extension was obtained in every case.
11. The ankle arthrodesis of Inclán yielded good results in every case in which it was employed.

EXCISION OF THE PATELLA IN ARTHRITIS OF THE KNEE JOINT. E. J. Berkheiser. *The Journal of the American Medical Association*, CXIII, 2303, 1939.

The uniformly good results following the complete or partial excision of the patella in fractures of this bone led the author to adopt this measure in certain well-selected cases of arthritis of the knee joint that did not respond to other forms of treatment.

The operation consists in removal of the entire patella through a vertical incision centered over the patella, followed by approximation of the edges of the synovial membrane over the patellar bed. The purpose of the procedure is to give the patient a knee free from pain with a usable range of motion.

Cases were chosen regardless of the primary etiological factor. The following criteria were used to select patients who would benefit from the procedure:

1. The duration of the disease was several years.
2. Repeated periods of conservative management resulted in improvement, followed by recurrences.
3. In the presence of bilateral lesions, the more severely involved joint was chosen, the other serving as a control.
4. The disease was quiescent at time of operation.
5. There was definite roentgenographic evidence of arthritis.
6. It was evident that extension of the leg on the thigh to 160 degrees could be obtained postoperatively.
7. The mental and physical state of the patient was such that he could stand or walk postoperatively.

The procedure was used in four cases of atrophic arthritis, three cases of hypertrophic arthritis, two cases of gonorrhoeal arthritis, and two cases of traumatic arthritis. There were four men and seven women, the youngest being thirty-five years old and the oldest, sixty-four years of age.

In each case the patient was allowed active use of the leg at the end of ten days. All showed progressive improvement from the first. There were good results in eight cases and fair in three not well-selected cases. There were no deaths, complications, or aggravation of the original condition.—*Brandon Carrell, M.D., Dallas, Texas.*

RECONSTRUCTIVE AND STABILIZING SURGERY FOR RESIDUAL SUPPURATIVE ARTHRITIS OF HIP JOINT: A STUDY OF FORTY-SIX UNSELECTED CASES. Halford Hallock. *The Journal of the American Medical Association*, CXIII, 2398, 1939.

Twenty reconstruction operations, four arthroplasties, seven shelf stabilizations, and fifteen fusion operations were done on thirty-eight patients at the New York Orthopedic Hospital and Dispensary in a seventeen-year period, ending in 1937. The indications for the several types of operation are discussed, and the end results are tabulated and evaluated.

The experience gained from this series shows that reconstructive procedures in children generally result in control of the dislocation and a painless hip, but with a limited range of motion. However, absence of pain may not be permanent, as these patients may experience pain on reaching adult age, because these are not mechanically sound joints. The arthroplastic operations give a better range of motion and usually a painless hip, but, unfortunately, in this type of hip there is generally not enough residual bone for this procedure. The shelf stabilizations with a properly placed shelf of sufficient size give the patient a stable, painless hip with an adequate range of motion, which will remain so unless joint irregularities between shelf, acetabulum, and femur develop. Because of shortening and adductor-muscle weakness, a limp frequently develops. Fusion with the hip in a straight position gives a permanently stable and painless hip, and is an operation that can be relied on.

The time of each of the operative procedures was carefully chosen, and the author states that it is advisable to wait at least two and often several years after all activity has ceased. The only way to decrease the number of these patients is to recognize the acute phase of the disease clinically and to institute early adequate drainage. A negative operative exploration is better than an untreated destructive infection.—*Henry H. Beckering, M.D., Dallas, Texas.*

SCIATIC NERVE PRESSURE FOLLOWING RUPTURE AND FIBROSIS OF A HAMSTRING MUSCLE.

P. M. Girard and H. M. Childress. *The Journal of the American Medical Association*, CXIII, 2412, 1939.

Muscles are usually ruptured by indirect violence when they are in a state of contraction. The muscle belly is torn across or the musculotendinous junction is separated. They may, however, be ruptured while in a resting state either by direct or by indirect violence. Torn muscle fibers do not regenerate themselves, and the defect that is caused upon separation is bridged across by fibrous connective tissue.

The authors report a case of rupture of the semitendinosus muscle, in all probability by indirect violence, in which suture resulted in healing by massive scar-tissue formation. In this case complete excision of the entire muscle was required later, due to the fact that the patient complained of sciatic paralysis when the leg was in full extension for any length of time. Motion of the knee and function of the leg were not disturbed by the operation, and the patient made a satisfactory recovery.—*Henry H. Beckering, M.D., Dallas, Texas.*

FRACTURE D'APOPHYSE TRANSVERSE CERVICO-DORSALE (Fracture of the Cervicothoracic Transverse Apophysis). P. Houssa et R. Verhamme. *Journal de Chirurgie et Annales de la Société Belge de Chirurgie*, XXXVIII-XXXVI, 167, 1939.

The authors report a case of this rather rare lesion. They review the literature and also explain the pathogenesis of the lesion.—*Robert Soeur, M.D., Brussels, Belgium.*

RAPPORTS DU KYSTE DU MÉNISQUE AVEC LES FORMATIONS KYSTIQUES D'ORIGINE CONJONCTIVE (The Relation between the Cyst of the Meniscus and Cystic Formations of Connective-Tissue Origin). G. Leemans. *Journal de Chirurgie et Annales de la Société Belge de Chirurgie*, XXXVIII-XXXVI, Oct. 1939.

Why do cysts of the meniscus almost always form at the level of the anterior portion

of the lateral meniscus? Based on the theories of Retteren (1896) in regard to the evolution of primitive connective tissue, the author thinks that anatomy explains the origin of these cysts of the lateral meniscus. The anterior third of the lateral meniscus is less firmly attached to the aponeurosis of the leg and is separated from it by connective tissue. In this loose portion of the meniscus cysts are formed, following pulling and rubbing of the aponeurosis against the meniscus.—Robert Soeur, M.D., Brussels, Belgium.

**MULTIPLE CYSTIC TUBERCULOSIS OF THE BONES. REPORT OF A CASE.** David W. Martin. *Journal of Pediatrics*, XV, 254, 1939.

The author reports a case of multiple cystic tuberculosis of bone, which apparently is the twelfth case reported in the paediatric literature. The usual criteria for bone tuberculosis are mentioned. The author states that the bone lesions reported in the eleven cases reviewed by Law and Perham were most commonly found in the smaller bones of the extremities; however, lesions were demonstrated in the humerus in several cases. In the author's case multiple myelomata and hyperparathyroidism were ruled out, and Boeck's sarcoid seemed unlikely.—A. I. Blieden, M.D., Iowa City, Iowa.

**VITAMIN E IN THE TREATMENT OF MUSCULAR DYSTROPHIES AND NERVOUS DISEASES.** Franklin Bicknell. *The Lancet*, I, 10, Jan. 6, 1940.

The writer reviews the work of Einarson and Ringsted on rats in Denmark, in which they suggest that muscular dystrophy, amyotrophic lateral sclerosis, and tabes dorsalis are due to a deficiency of vitamin E. He used fresh, dried, whole-wheat germ, one-half an ounce twice daily, in treating eighteen cases of muscular dystrophy, four cases of amyotrophic lateral sclerosis, two cases of tabes dorsalis, one case of peroneal muscular atrophy, and one case of amyotonia congenita. In the group of the myopathies every patient who was treated for more than six weeks improved, except one who was mentally deficient. The author had insufficient cases of amyotrophic lateral sclerosis, tabes dorsalis, and peroneal muscular atrophy, but he feels that the results in the cases of amyotrophic lateral sclerosis were promising. The one patient with amyotonia congenita, a female, two and one-half years old, showed satisfactory improvement. The author feels that the results of the clinical use of vitamin E support the belief that muscular dystrophy and amyotrophic lateral sclerosis are deficiency diseases.—Lenox D. Baker, M.D., Durham, North Carolina.

**SOGENANNT E LOKALISIERTE OTITIS FIBROSA UND TRAUMA (So-Called Localized Osteitis Fibrosa and Trauma).** Georg Ernst Konjetzny. *Monatsschrift für Unfallheilkunde und Versicherungsmedizin*, XLVI, 572, 1939.

This is a case report of a patient, thirty years old, who had sustained a direct trauma to the thigh. The pain caused by the injury subsided after a few days. Two months later symptoms of a rheumatic nature developed at the site of the trauma. The patient continued his activities as a seaman for twenty months. The clinical and roentgenographic findings led to a diagnosis of osteomyelitis with a central abscess. At operation, the tissue had the appearance of a brown giant-cell tumor. Histological examination showed a subperiosteal destruction and displacement by a cellular spindle-cell tissue containing giant cells. The cortex was partly destroyed, and massive periosteal new-bone formation, together with less pronounced endosteal ossification, was evident.

The author considers this case as another example of the development of brown giant-cell tumors on the basis of traumatism.—R. J. Diltrich, M.D., Fort Scott, Kansas.

**OSTEOMYELITIS UND TRAUMA (Osteomyelitis and Trauma).** Rosenbach. *Monatsschrift für Unfallheilkunde und Versicherungsmedizin*, XLVI, 597, 1939.

The author reports two cases of osteomyelitis followed by trauma in support of the theory that a relationship between them can be established. In addition, two cases of

healed osteomyelitis are reported, in which a recurrence followed trauma.—*R. J. Ditt-rich, M.D., Fort Scott, Kansas.*

**PENTOTHAL: THE ANESTHETIC AGENT OF CHOICE FOR THE REDUCTION OF SIMPLE FRACTURES.** Phillip S. Marcus. *The New England Journal of Medicine*, CCXXII, 137, Jan. 25, 1940.

Marcus, who is a Resident anaesthetist at the Boston City Hospital, reports the use of pentothal in 300 cases of fracture in which the patients were ambulatory. He discusses the various forms of anaesthesia and shows that the use of a barbiturate such as pentothal or evipal is of advantage in cases where the patients leave the hospital after reduction. In only one case was there depression of respiration that required oxygen therapy, and in this case there was an uneventful recovery. Vomiting occurred once. The author claims there is an adequate margin of safety.—*Mark H. Rogers, M.D., Boston, Massachusetts.*

**THE TREATMENT OF ATROPHIC ARTHRITIS WITH ESTROGENIC SUBSTANCE.** Abraham Cohen, Alfred W. Dubbs, and Abraham Myers. *The New England Journal of Medicine*, CCXXII, 140, Jan. 25, 1940.

The writers are from the Arthritis Clinics of the Philadelphia General Hospital and the Jefferson Medical College Hospital. Basing their work on the well-known assumption that there may be a connection between the menopause and atrophic arthritis, they took a series of twenty-three cases—seventeen of the atrophic type and six of the mixed type—and treated them with rather large doses of estrogen in the form of progynon. They found that those patients who had no disturbance in menstrual function showed little benefit, but they believe that the improvement shown in cases with menopausal symptoms warrants the use of this estrogenic substance as a form of treatment in atrophic arthritis.—*Mark H. Rogers, M.D., Boston, Massachusetts.*

**THE BONE LESIONS ACCOMPANYING CERVICAL SPINAL-CORD INJURIES. AN END-RESULT STUDY OF 76 CASES.** Donald Munro and Walter Wegner. *The New England Journal of Medicine*, CCXXII, 167, Feb. 1, 1940.

The authors point out that the therapy and prognosis of injuries of the cervical spine that do not involve the cord are quite different from those in cases in which cord injury plays a part; also, that it is essential to differentiate between the true acute cord injury which occurs at the time of the accident and the chronic lesion in which damage to the cord takes place later. They also emphasize the futility of using for injuries of the cervical spine and the cervical cord methods of treatment that are properly applied to thoracic or lumbar lesions.

Cervical dislocations are most likely to occur between the first and second vertebrae and between the fourth, fifth, and sixth vertebrae. Nearly all are the result of indirect violence, which causes excessive flexion.

Diagnosis is made roentgenographically for the most part, and is occasionally supplemented by laminectomy or autopsy.

Treatment depends on the damage to the cord and the presence or absence of spinal subarachnoid block. The initial treatment consists in traction applied either by a halter made of three-inch flannel bandage or by a loop of rustless-steel wire passed through two adjacent burr holes in the skull on either side of the mid-sagittal plane, as advocated by Cone and Turner. Traction is maintained for at least six weeks, usually eight or nine. The patient is then fitted with a leather cuirass or a leather Thomas collar, depending on the roentgenographic evidence of bone repair. After another six weeks or two months, the splint may be removed at night, but it should be worn during the day or whenever the patient is in the upright position, until roentgenographic examination shows solid bony

union. No special exercises are given, and plaster jackets are not advised, because of their weight and the discomfort and increased incidence of bed sores which follow their use. The authors have proved that laminectomy in the early stages is not advisable and, by the conservative treatment described, have reduced the mortality over 30 per cent.

The paper is based on a series of seventy-six cases, thirty of which have been followed from one to fifteen years. There have been only two recurrences and no late development of secondary cord symptoms. Thirty-four patients died before discharge. Of the thirty living patients, satisfactory end results have been obtained in twenty-eight.—

Mark H. Rogers, M.D., Boston, Massachusetts.

LES LACUNES D'OSSIFICATION DE LA VOUTE CRANIENNE (Ossification Defects in the Cranial Vault). Y. Gayrard. *La Presse Médicale*, XLVII, 1480, 1939.

Defects in cranial ossification may be seen in enlarged pachionian bodies, in syphilis, craniotabes, cleidocranial dysostosis, xanthomatosis, and other diseases. The defects to which the author calls attention differ from these others in that they are usually bilateral and symmetrical. They are large and occasionally exceed seven centimeters. These defects are elliptical in shape and are directed perpendicularly or at angles of not less than 45 degrees to the axis of the longitudinal sinus. The opening on the outer table is usually larger than that on the inner table. The defects are usually congenital and familial.

After discussing various theories as to etiology, the author expresses the opinion that they are to be attributed to a microcephalia, which is very commonly found in such cases.—Henry Milch, M.D., New York, N. Y.

APROPOS DU TRAITEMENT D'URGENCE DES PLAIES PÉNÉTRANTES DES ARTICULATIONS (The Emergency Treatment of Penetrating Articular Wounds). Antoine Basset. *La Presse Médicale*, XLVII, 1493, 1939.

If penetrating wounds of joints can be brought to the attention of a competent surgeon in a properly equipped hospital within from eight to ten hours of the injury, the function of the joint can best be preserved by primary closure of the synovial wound. Before any surgical intervention is attempted, a roentgenogram, to survey the extent of bone damage, should be carefully taken. Operation should be performed under spinal or general anaesthesia, never under local anaesthesia. The skin wound should be carefully excised back to healthy tissue. All devitalized subcutaneous tissues should be sharply cut away. If the skin wound does not permit careful exploration of the articular cavity, the primary wound should be closed, and a typical arthrotomy incision should be made. The joint should be carefully washed out, and all blood clots and bone fragments should be removed. Thereafter the joint may be closed by primary suture. If the bone injury warrants it, immobilization with a plaster-of-Paris bandage may be employed; otherwise, simple splinting is satisfactory. Each case must be individualized under the general principles enumerated.—Henry Milch, M.D., New York, N. Y.

LA SYMPATHICTECTOMIE LOMBAIRE, L'INFILTRATION NOVOCAÏNIQUE LOMBAIRE, L'INJECTION INTRA-ARTÉRIELLE DE NOVOCAÏNE, LA RÉSECTION UNILATÉRALE DES NERFS SPLANCHNIQUES, ET LA VALEUR COMPARÉE DE L'EFFET DE CES INTERVENTIONS SUR LE DÉVELOPPEMENT DE LA CIRCULATION COLLATÉRALE DES MEMBRES (Lumbar Sympathectomy, Novocain Infiltration of the Lumbar Sympathetic Nerves, Intra-Arterial Injection of Novocain, Unilateral Resection of the Splanchnic Nerves, and the Comparative Value of These Procedures in the Development of Collateral Circulation in the Extremities). Sausa Pereira, Alvaro Rodrigues, et Roberto Carvalho. *La Presse Médicale*, XLVII, 1545, 1939.

To determine the effect of various procedures designed to increase collateral circulation in the extremities, the authors performed preliminary obliteration of the superficial

radicular. Root pain is sharp and may be burning or gnawing, but it is rarely aching. It tends to follow segmental distribution, but it may follow the course of the sciatic or peroneal nerves. This pain is often aggravated by coughing, sneezing, straining, and sharp flexion of the neck; it tends to be worse at night; and it may be relieved by walking or by sleeping in a chair. Radicular pain is frequently associated with paraesthesia, reflex changes, muscle weakness or atrophy, sensory changes, or loss of sphincteric control.

At The Mayo Clinic, of about 10,000 cases of low-back and sciatic pain seen in the past three years, in only 300 could a diagnosis of probable protruded intervertebral disc be made. In fifteen of these cases the protrusions were in the cervical and thoracic regions and in 285 they were in the lumbar area. The protrusions were multiple in thirty cases. There were 226 males and only seventy-four females. Forty-one per cent. of the patients could recall no injury, and only 37 per cent. remembered that the injury immediately preceded the onset of symptoms. Eighty-one per cent. reported intermittence of symptoms,—one of the most characteristic features of the syndrome. Sciatic pain was unilateral in 85 per cent.

The most important neurological signs of protruded intervertebral disc are: Lasègue's sign, the presence of sciatic tenderness, and the diminution or absence of the Achilles reflex. In most cases there was obliteration of the normal lumbar curve and limited and painful back movements. The only spinal-fluid test found to be of value in diagnosis of protruded disc was the concentration of total protein.

Neurological examination may be negative in the presence of a protruded disc (6 per cent.), or it may show only a positive Lasègue sign or sciatic tenderness, or both (15 per cent.). Such cases were treated conservatively; if unrelieved, spinal puncture was done. In case of a normal spinal fluid, epidural injection and a reversed Queckenstedt test were done. If the former pain was reproduced, or if the reversed Queckenstedt test was positive, the contrast medium was injected to localize the lesion. Since lesions in the lower thoracic region may give a clinical picture similar to those involving the cauda equina, it is usually not possible to dispense with the use of contrast media.—*Edward N. Reed, M.D., Santa Monica, California.*

#### SIGNIFICANT SKELETAL CHANGES IN LOW BACK AND SCIATIC PAIN: ROENTGENOLOGIC OBSERVATIONS. Ralph S. Bromer. *Radiology*, XXXIII, 688, 1939.

The following congenital variations are frequently encountered and their causal relationship to low-back pain has not been proved:

1. Slightly bifid posterior spinous processes of the fifth lumbar vertebra or upper sacral segments.
2. Lumbarization of the fifth lumbar vertebra, unilateral or bilateral.
3. Sacralization of the fifth lumbar vertebra, unilateral or bilateral.
4. Exaggerated or decreased lumbar lordosis.
5. Scoliosis of the lumbar vertebrae of mild degree, with or without actual rotation.
6. Elongated transverse processes, often with partial sacralization.
7. "Butterfly" type of transverse processes of the fifth lumbar vertebra.
8. Impingement of the transverse processes of the fifth lumbar vertebra on the iliac crests.

Other observers have found the incidence of sciatic radiation in low-back pain twice as great in those with congenital anomalies as in those without. Among skeletal changes which probably do have relationship to low-back pain are the following:

*Defects in the Neural Arch:* These have been described as "the separate neural arch" or "prespondylolisthesis".

*Changes in the Articular Facets:* These are especially concerned with sciatic radiation. At times there are accessory articular processes; at times, fractures of the articular processes, which are demonstrable only by a meticulous technique.

*Narrowed Lumbar Joint Space:* This is believed to be due to degeneration of the nucleus pulposus from trauma, resulting in a mechanically altered lumbosacral articula-

tion. The pain is thought to be a root pain, due to compression in the intervertebral foramina.

*Posterior Luxations of the Lumbosacral Joint:* The idea that apparent posterior displacement of the body of the fifth lumbar vertebra on the sacrum, as judged by the posterior alignment, is pathological is brought in question because of the fact that the depth of the opposing surfaces is often unequal, the sacral diameters tending to be shorter than the lumbar.

*Platyspondylia:* This is a congenital anomaly consisting in a widening of a vertebral body, with a diminished vertical diameter. Putti states that this condition predisposes to "lumbago".—*Edward N. Reed, M.D., Santa Monica, California.*

#### AIR MYELOGRAPHY IN THE DIAGNOSIS OF INTRASPINAL LESIONS PRODUCING LOW BACK AND SCIATIC PAIN. W. Edward Chamberlain and Barton R. Young. *Radiology*, XXXIII, 695, 1939.

The authors have used air instead of lipiodol, because of possible harmful effects of lipiodol and the difficulty of its removal. Because of their absorbability, gaseous contrast media may be freely used whenever there is suspicion of an intraspinal lesion. This method is especially valuable for demonstration of the lumbocaudal sac. Examination of this sac is indicated in any patient with persistent sciatic pain who shows abnormalities in Achilles reflex, or in sensation of heat and cold over the dorsum of the foot, or impairment of muscle power in the foot.

The method has been very dependable in the authors' hands. The boundaries of the subarachnoid space are sharply delineated by air, so that any change of configuration of the margins can be visualized by roentgenograms.

A tumor may completely occlude the subarachnoid space, causing a block, which a Queckenstedt test will disclose. A small quantity of air—four to six cubic centimeters—should be injected anyway, to show the under surface of the tumor.

When complete or partial block is shown by the Queckenstedt test, from four to six cubic centimeters of air are injected below the suspected level of the lesion. The patient, sitting upright, is placed against a Bucky diaphragm, and stereoscopic anteroposterior and lateral projections are made. When no block is shown by the Queckenstedt test, the entire lumbocaudal sac is visualized by placing the patient on the side, in the Trendelenburg position, at an angle of from 30 to 35 degrees. Through a needle in the second lumbar interspace spinal fluid is exchanged for air in five-cubic-centimeter volumes until air returns from the needle; from thirty to fifty cubic centimeters of air are required to fill the space. Stereoscopic anteroposterior and lateral projections are then made, the Trendelenburg position being maintained to prevent the ascent of air into the cranium. Lateral projections may also be made with the spine in hyperflexion and in hyperextension, and may show whether the position of herniated intervertebral discs can be changed by these positions.—*Edward N. Reed, M.D., Santa Monica, California.*

#### INTRASPINAL LESIONS ASSOCIATED WITH LOW BACK PAIN AND SCIATIC PAIN, AND THEIR LOCALIZATION BY MEANS OF LIPIODOL WITHIN THE SUBARACHNOID SPACE. John D. Camp and Ercell A. Addington. *Radiology*, XXXIII, 701, 1939.

While lipiodol is an irritant to the spinal meninges, its advantages far outweigh any disadvantages, when used judiciously. Air injection will reveal certain lesions of the spinal cord and the cauda equina and should be used more frequently before resorting to lipiodol. However, the authors' experience with both methods shows that lipiodol is more accurate, it reveals certain structures not seen with air, and it localizes structures which air fails to show. In the thoracic and cervical regions the superiority of lipiodol is most evident.

Five cubic centimeters of lipiodol are injected via the lumbar route. A tilting fluoroscopic table is necessary. Some device for recording the fluoroscopic image by making

a "spot" film is needed; also a large film, including several vertebrae, is required to determine the anatomical level.

Low-back and sciatic pain may be associated with cervical-cord tumors, as in 31.8 per cent. of the authors' 100 consecutive cases of tumor of the cervical cord. The same pain was present in 50 per cent. of their cases of tumor of the thoracic cord, and in 83 per cent. of their cases of tumor in the lumbar region. Lesions diagnosed with lipiodol injection, with the percentage of errors, were: cord tumors (14 per cent. error), protruded intervertebral disc (4.4 per cent. error), hypertrophied ligamentum flavum (no error). In lipiodol examinations reported negative there was 8.7 per cent. error. Hypertrophy of the ligamentum flavum is usually associated with protrusion of the disc at the same level. This hypertrophy compresses the lipiodol column posteriorly and laterally. Protrusion or hypertrophy at the lumbosacral junction may fail to be demonstrated by lipiodol because of the small size of the terminal caudal sac or an anomaly of the cul-de-sac.

It is difficult to appraise the reaction to lipiodol, because operation is ordinarily carried out promptly following the injection. The authors believe that the reaction following the use of five cubic centimeters is no greater than that following the use of two cubic centimeters. Walsh and Love found as great a change in the spinal fluid following air injection as following lipiodol injection. They state that iodized oil produces a mild and benign meningeal irritation, and they have seen no reaction to it that might not have been produced by spinal or cisternal puncture with withdrawal of spinal fluid alone.—

*Edward N. Reed, M.D., Santa Monica, California.*

**FRACTURA DE MONTEGGIA** (Monteggia's Fracture). Renato da Costa Bonfim. *Revista Brasileira de Orthopedia e Traumatologia*, I, 18, 1939.

The author describes two cases of this type which is defined as a fracture of the diaphysis of the ulna, associated with a dislocation of the head of the radius. The author presents an analysis of the mechanism with illustrations. The fracture and the dislocation of the radius occur simultaneously, displacement of the radial head being governed by the location of the fracture of the ulna. The importance of early diagnosis and the success of conservative immediate treatment are emphasized. Monteggia first described the lesion in 1814, and a complete bibliography is given by the author.—*Emanuel B. Kaplan, M.D., Bronx, New York.*

**TRATAMENTO CIRURGICO DA LUXAÇÃO RECIDIVANTE DE ESPADUA** (Surgical Treatment of Recurrent Dislocation of the Shoulder). Miguel Calmon Filho. *Revista Brasileira de Orthopedia e Traumatologia*, I, 37, 1939.

A short general description of the principal methods of surgical treatment of habitual dislocation of the shoulder, with a critical analysis, is given by the author. Finding most of these methods rather complicated, the author describes the procedure of Louis Bazy, which he found simple and very satisfactory.

Through an incision along the sulcus of the deltoideus pectoralis junction, the coracoid process is approached. A longitudinal groove is made in the external border of the horizontal portion of the coracoid. A preliminary bone graft, six centimeters long and two centimeters wide, taken from the tibia, is then inserted into the groove in such a fashion that one end is fixed in the groove and the rest of the graft is sutured to the coracobrachialis tendon along its course toward the arm. Postoperative immobilization was maintained for thirty days. In one case, the author obtained a good result with normal motion in all directions.—*Emanuel B. Kaplan, M.D., Bronx, New York.*

**CONTRIBUIÇÃO AO TRATAMENTO CIRURGICO DA ESPONDILOLISTESE** (Contribution to the Surgical Treatment of Spondylolisthesis). Achilles de Araujo. *Revista Brasileira de Orthopedia e Traumatologia*, I, 83, 1939.

The author describes in detail three cases. Conservative treatment is believed to be inefficient. The author recognizes a prespondylitic stage, which is characterized by the



usual painful disturbances and discomfort. This stage is the most favorable for surgical intervention. Successful surgical arthrodesis eliminates all the symptoms. The author recommends double rigid paravertebral osteopariosteal grafts, both ends of which are inserted into the lumbar and sacral laminae.—*Emanuel B. Kaplan, M.D., Bronx, New York.*

TRAITEMENT DES FRACTURES DE LA CAVITÉ COXYLOÏDE (Treatment of Fractures of the Acetabulum). J. P. Grinda. *Revue d'Orthopédie et de Chirurgie de l'Appareil Moteur*, XXVI, 289, 1939.

The treatment of these fractures requires three fundamental considerations,—exact reposition of fragments, adequate immobilization until union takes place, and uninterrupted motion of the hip joint to prevent ankylosis. The author uses continuous traction; this may be either adhesive or skeletal. In one case the reduction of the fracture was accomplished by pressure through the rectum. Analyzing his own six cases and the methods used by various surgeons, the author arrives at the conclusion that the continuous-traction method is better than the method of immediate reduction by forced extension followed by plaster-of-Paris immobilization. Transtrochanteric skeletal traction may be used only in a limited number of cases. The continuous traction has the advantage of permitting the patient to move the hip from the beginning of treatment.—

*Emanuel B. Kaplan, M.D., Bronx, New York.*

NOTE SUR UN PROCÉDÉ CLINIQUE DE MESURE DE L'ANTEVERSION DU COL FÉMORAL (A

Clinical Procedure for Measurement of Anteversion of the Femoral Neck). Robert Netter. *Revue d'Orthopédie et de Chirurgie de l'Appareil Moteur*, XXVI, 347, 1939.

The author proposes a rapid method of measurement of the anteversion of the femoral neck. The patient lies on the end of a table with the legs hanging down, and the examiner's hand is placed flat on the greater trochanter of the side under examination. The injured leg is abducted at the knee, and the examiner then feels the trochanter becoming more and more pronounced until the femoral neck is parallel to the surface of the table. Further abduction of the leg imparts the feeling of medial recession of the trochanter. The angle of maximum abduction of the leg, which corresponds to the maximum prominence of the trochanter, shows the amount of anteversion of the femoral neck. The method was verified by several examiners and checked with findings during operations. It was found to be sufficiently correct for clinical purposes.—*Emanuel B. Kaplan, M.D., Bronx, New York.*

STAPHILO-RÉACTION ET RHUMATISME STAPHYLOCOCCIQUE. Fl. Coste, R. Demanche, et M. Morin. *Revue du Rhumatisme*, VI, 945, 1939.

The staphylococcus reaction was recorded in 473 patients suffering from rheumatism. The reaction was positive in eighty instances. The authors found in most of the eighty reacting patients evidence of a specific staphylococcus affection. Of eighty other patients who had a negative staphylococcus reaction, there were only three who had had an antecedent staphylococcus infection. Of the eighty patients with a positive staphylococcus reaction, there were twenty-six with rheumatic manifestations. Their observations of positive staphylococcus reaction included cases of polyarthritides, hydrarthrosis, and spondylarthrosis. In the treatment of these hidden staphylococcus infections they utilized chiefly a 1 to 200 sulphate-of-copper solution, injecting five cubic centimeters intravenously every two or three days. With this treatment they obtained a "cure" in a certain number of cases. Antitoxin therapy and vaccine therapy were at times employed with the copper sulphate. The authors feel that, in addition to the other measures, it is of value to direct treatment against staphylococcus infection where there is a positive staphylococcus reaction.—*John G. Kuhns, M.D., Boston, Massachusetts.*

THE TREATMENT OF ARTHRITIC DEFORMITY BY LACTIC ACID INJECTION. W. Waugh. *Rheumatism*, I, 15, 1939.

This treatment is divided into three parts: lactic-acid injection into and around affected joint, which excites a local phagocytic cellular reaction, followed by a process of proliferation and repair; a period of physiological rest to the joint during the stage of reaction; and, later, prolonged physical therapeutic measures.

As proof that tissues do respond to acid the facts are pointed out that hematomata about the ends of fractured bones excite brisk phagocytosis and mesoblastic tissue formation; that pus in granulating osteomyelitic cavities is acid; and that a lotion of zinc sulphate with a hydrogen-ion concentration of 6 promotes healing in sluggish wounds. In normal joints the contents are acid, whereas in chronic rheumatic joints the condition is reversed.

The affected joints are manipulated forty-eight hours after the lactic-acid injection. They are then immobilized for from ten to fourteen days. In three cases of bilateral arthritis of the knee joint only one knee of each patient was injected, although all other measures for the joints were identically the same. Recovery was obtained only in the injected joints.

The solution is made by combining 0.2 per cent. N/5 lactic acid with 2 per cent. novocain and 0.5 per cent. sodium chloride. The usual amounts injected into the joint are from three to five cubic centimeters and from ten to fifteen cubic centimeters into the adjacent soft tissues. The best results were obtained in rheumatoid arthritis; fifty such cases were treated, with resultant improvement in practically all of them.—*Harold M. Childress, M.D., Jamestown, New York.*

STOCK VACCINE IN THE TREATMENT OF CHRONIC RHEUMATIC DISEASE. H. Warren Crowe. *Rheumatism*, I, 24, 1939.

If the right case is treated by the correct vaccine and method, stock vaccine is effective in the treatment of chronic rheumatic disease. Of 4000 cases, in which stock vaccine alone was used, good results were obtained in 50 per cent. and improvement was noted in another 35 per cent.

A gradual conception of rheumatic disease has taken place which postulates the cause of chronic arthritis as being due to aberrant activity of the ordinary microbes of the human body. These are mostly of the streptococcic and staphylococcic groups. The general principle involved in vaccine therapy is to attempt to sensitize the patient to his bacterial infection. The body tissues, therefore, are stimulated to attack the invader. It is important to use only small doses of vaccine, since large amounts do not produce adequate sensitization.

The treatment of arthritic conditions which have produced deformities consists in arresting the disease by vaccine injections, removing all foci of infection, and then employing such manipulative or surgical corrective procedures as may be indicated. Generally speaking, the older the person and the less active the disease, the more justifiable is reliance upon stock-vaccine therapy.—*Harold M. Childress, M.D., Jamestown, New York.*

PRIMARY PURULENT PSOITIS. M. Mikula. *Slovanský Sborník Ortopedický*, XIV, 1939.

The non-tuberculous psoas abscess is an independent lesion, usually involving children of school age. It is often mistaken for tuberculosis of the hip, appendicitis, or even strangulated hernia. The origin is an infectious hematoma following trauma or a purulent infection. In the majority of the cases the origin of the infection cannot be established. The symptoms are those of functional impairment of the muscles due to the suppuration. The patient has sudden pain, often referred to the knee or into the abdomen. The limb is in flexion and abduction. The patient limps and has difficulty in walking. All movements in the direction of flexion and rotation are painless. Extension

is painful and often is locked. The temperature rises to 102 degrees or higher, and there is leukocytosis. Adjacent to the anterior superior iliac spine there is found a retroperitoneal tumor, which is usually hard, painful to pressure, and sometimes fluctuant. Aspiration or puncture gives a positive result, and the bacteriological examination confirms the diagnosis. Treatment consists in simple incision and drainage. Traction upon the limb is recommended in order to overcome the flexion contracture.

Among 10,000 cases treated surgically, the author found primary purulent psoitis in thirty-six cases. There was a history of trauma in seven of these, and a primary inflammatory process with acute perforating appendicitis in one case. A metastasis from the axillary glands was found in one case, and in two cases the psoas abscess formed in the course of infectious diseases such as measles and chicken pox. In twenty-five cases there was no trauma or primary focus. Bacteriological examination revealed the presence of the staphylococcus in seven cases; streptococci or mixed infection is less frequent. In one very refractory case an actinomycosis was found.—*Arthur Steindler, M.D., Iowa City, Iowa.*

ORTHOPEDIC CARE OF CONVALESCENT POLIOMYELITIS. REPORT OF 63 CASES ONE YEAR FOLLOWING ACUTE ONSET. W. Vernon Newman. *Southern Medical Journal*, XXXII, 900, 1939.

This is a report on sixty-three cases one year following the acute attack. No new method is offered, but rather a modified application of existing plans is suggested. Many patients show marked loss of weight. As nutritional improvement and functional improvement go together, great care should be taken to build up the nutritional state of the patient. The author recommends prolonged rest in circular plaster casts. The casts are not applied until the acute symptoms have subsided, usually at the end of from two to three weeks. The casts are changed at three-month intervals, on account of increase in weight and size of the limbs. Prolonged fixation does not result in joint stiffness. Braces are used after 50 per cent. of function has returned to the muscles. The average time in the cast was from two to twelve months, and braces were used for an additional period of from two to six months. Hydrotherapy is preferred to any other form of physical therapy. It can be carried out in the family bath tub. A table is given showing results.—*Fred G. Hodgson, M.D., Atlanta, Georgia.*

A METHOD OF APPLICATION OF SKELETAL TRACTION FOR TREATMENT OF CONTRACTURE OF THE KNEE. D. H. O'Donoghue. *Southern Medical Journal*, XXXII, 1023, 1939.

A Kirschner wire is inserted through the crest of the tibia at its proximal end. Vertical traction is obtained by suspension to an overhead bar. Another Kirschner wire is inserted through the os calcis, and horizontal traction is applied. The exact amount of weight varies with the individual case.

Nine cases are reported. There were few complications and no unfortunate sequelae. One case was a failure, due to non-cooperation on the part of the patient.—*Fred G. Hodgson, M.D., Atlanta, Georgia.*

THE CONSERVATIVE TREATMENT OF CONGENITAL CLUB FEET IN INFANTS. L. Stanley Sell. *Southern Medical Journal*, XXXII, 1199, 1939.

The method is essentially the same as that of Dr. J. H. Kite. One difference is that the author uses an adhesive shellac or compound tincture of benzoin beneath the cotton flannel and carries the cast from the toes only as high as the knee. He ignores any torsion of the tibia and, if necessary, corrects this by osteotomy after the foot deformity has been overcome. A table of the results of this method in seventy cases is included.—*Fred G. Hodgson, M.D., Atlanta, Georgia.*

**PATHOLOGY AND OPERATIVE CORRECTION OF FINGER DEFORMITIES DUE TO INJURIES AND CONTRACTURES OF THE EXTENSOR DIGITORUM TENDON.** Emanuel B. Kaplan *Surgery*, VI, 35, 1939.

The author describes in detail the anatomy and physiology of the finger tendons and notes several errors in the description given in standard texts. He discusses four pathological conditions in the light of these anatomical researches.

1. In Dupuytren's contracture he finds that the finger flexion is due to contracture of the longitudinal pretendinous bands of the palmar aponeurosis, which insert into the lateral bands of the extensor apparatus and not into the periosteum of the phalanges. He considers it important in the operative excision of the contracted fascia to remove the longitudinal pretendinous bands of the palmar aponeurosis from the palm of the hand and from the fingers, and especially to separate these aponeurotic expansions from the lateral bands of the extensor tendon.

2. A study of mallet or baseball finger resulted in the finding that the pathology is a tear in the extensor tendon at the middle or distal third of the middle phalanx and not at the base of the distal phalanx. For repair of such a tear, a U-shaped incision, with the free end of the flap at the level of the proximal interphalangeal joint, is used.

3. A deformity described as hyperextension of the proximal interphalangeal joint is believed by the author to be due to a tear of the lateral ligaments of the proximal interphalangeal joint with resultant dorsal dislocation of the lateral bands of the extensor tendon. He recommends operative repair of the lateral ligaments through two laterally placed incisions.

4. An injury described as "buttonhole tear of the extensor apparatus" results in flexion deformity of the proximal interphalangeal joint and extension of the distal phalanx at the distal interphalangeal joint. Correction is obtained by suturing the lateral bands together over the dorsum of the middle phalanx.

The article is well illustrated; the anatomy and operative technique are described in detail; and surgeons dealing with finger injuries should read the article in its entirety.

**LESIONS OF THE INTERVERTEBRAL DISC AND LIGAMENTUM FLAVUM OF THE LUMBAR VERTEBRAE. AN ANATOMIC STUDY OF 75 HUMAN CADAVERS.** Thomas Horwitz. *Surgery*, VI, 410, 1939.

The author examined the lumbar spines of seventy-five adult male human cadavera, aged forty-five to eighty years, with particular reference to the intervertebral discs and ligamentum flavum. Narrowing of the lumbosacral disc was found in fifty specimens. The disc between the fourth and fifth lumbar vertebrae was narrowed in thirty-six specimens; between the third and fourth lumbar vertebrae, in twenty-seven specimens; and between the second and third lumbar vertebrae, in nineteen specimens. There were associated lipping and spur formation of the adjacent margins of the vertebrae. Protrusions of the intervertebral disc into the vertebral body (Schmorl's nodules) were found in the third lumbar vertebra in six specimens; in the fourth lumbar vertebra, in four specimens; in the fifth lumbar vertebra, in two specimens; and in the first sacral vertebra, in one specimen. Anterior spondylolisthesis of the fifth lumbar vertebra on the first sacral vertebra occurred in two cases; of the fourth lumbar vertebra on the fifth lumbar, in two cases; of the third lumbar vertebra on the fourth lumbar, in one case. In none of the cases was there abnormal tension on the caudal nerve roots. Posterior displacement of the fifth lumbar vertebra on the sacrum was found in nine specimens, the displacement amounting to from two-sixteenths to four-sixteenths of an inch. Unilateral posterior herniation of the intervertebral disc was demonstrated in four cases: in one, between the second and third lumbar vertebrae; in one, between the third and fourth lumbar vertebrae; in one, between the fourth and fifth lumbar vertebrae; and in one, arising from the lumbosacral disc. Posterior bulging of the annulus fibrosus of the disc across its entire width without true herniation was found in twenty-one instances between the fifth lumbar and first sacral vertebrae; in nineteen instances, between the fourth and fifth lumbar

vertebrae, in nine instances, between the third and fourth lumbar vertebrae; and once, between the second and third lumbar vertebrae. In no instance in this series was a spinal nerve unduly compressed either within the spinal canal or at its exit through the intervertebral foramen.

In nine instances, the histories of the cases were reviewed and were negative for marked backache or the sciatic-pain syndrome. The author measured the thickness of the ligamentum flavum and found that it varied between one and five-tenths and six millimeters, with an average of three and six-tenths millimeters. In no case did the ligamentum flavum seem to exert undue pressure on the caudal nerve roots. There was apparent forward bulging of the ligamentum flavum, which constricted the intervertebral foramen between the fifth lumbar and first sacral vertebrae in four specimens on the right side and in three specimens on the left, and between the fourth and fifth lumbar vertebrae in two specimens on the right side. This bulging was found to be due to advanced marginal proliferation of the articular facet and not to hypertrophy of the overlying ligamentum flavum.

The author concluded that posterior protrusions of the intervertebral disc may be asymptomatic and yet large enough to produce defects in the intraspinal column of air or iodized oil.

**ACUTE TRAUMATIC DISLOCATION OF THE TENDON OF THE LONG HEAD OF THE BICEPS BRACHII. A REPORT OF SIX CASES WITH OPERATIVE FINDINGS.** Leroy C. Abbott and John B. de C. M. Saunders. *Surgery*, VI, 817, 1939.

The authors report in detail six cases of dislocation of the biceps tendon. In each instance the dislocation followed immediately after a definite trauma, and there was complete disability of the affected shoulder with accompanying pain and swelling on the anterior aspect of the joint. There was limitation of motion of the shoulder in forward flexion and abduction, and there was pain on forced supination of the forearm against resistance, the elbow being held in flexion. Tenderness was elicited on palpation over the bicipital groove, and there was a definite snapping sensation on abduction and external rotation of the shoulder.

In each case operation disclosed a displacement of the tendon over the lesser tuberosity. The authors recommend operation in every case with fixation of the tendon in the groove, or in those cases in which there is concomitant rupture of the musculotendinous cuff of the capsule, replacement of the tendon, and repair of the roof of the groove by fascia.

There is a careful review of the literature on the subject with a discussion of the pertinent anatomy and physiology.

**THE FORMATION OF GANGLIA AND CYSTS OF THE MENISCI OF THE KNEE. OBSERVATIONS ON THE GOLGI APPARATUS.** E. S. J. King. *Surgery, Gynecology and Obstetrics*, LXX, 150, Feb. 1940.

The writer's theory is that ganglia and cysts of the menisci are the results of cellular activity and are not areas of degeneration. This is shown through special staining of the Golgi apparatus of these cells. It is demonstrated that there is hypertrophy of the Golgi apparatus in all instances. In a degenerating area the Golgi apparatus is known to disintegrate, which is not the case here. The mucoid content of the cysts is a product of the secretory activity of the cells. The characteristics of the Golgi apparatus are thoroughly discussed and well illustrated by photomicrographs—Richard McGovney, M.D., Santa Barbara, California.

**TREATMENT OF FRACTURES OF THE SHAFT OF THE HUMERUS BY HANGING CAST.** John A. Caldwell. *Surgery, Gynecology and Obstetrics*, LXX, 421, Feb. 1940.

Fractures of the shaft of the humerus present special problems because: (1) the humerus is the most freely movable long bone, (2) its function is that of a lever with angle stress, and (3) in the vertical position the axis is influenced by gravity alone.

Two fundamental types of treatment—rigid immobilization and some form of traction in the long axis—with their advantages and disadvantages are discussed. The latter type is preferred and is obtained by application of a plaster cast from the wrist to the axilla with the elbow at 90 degrees of flexion and the forearm in mid-pronation. A wire loop, incorporated near the distal end, serves as a sling holder. If the fracture is high, some abduction is obtained by padding the inner aspect of the elbow. If for some reason the patient cannot be ambulatory at first, balanced traction in bed with the arm in 45 degrees of abduction and the elbow flexed at 90 degrees is started. Later the hanging cast is applied. The patient should avoid resting on the elbow and should sleep with the shoulders elevated. Rotation of the humerus is started in ten days and abduction, within the limitation of pain, in two weeks. Union is usually complete in eight weeks. Abduction function is delayed no longer than in aeroplane-splint treatment.

Only one case of non-union was encountered in 108 cases; eighty-five patients showed good union and function, and six more had good function with poor position.—*Richard McGovney, M.D., Santa Barbara, California.*

**HIP ARTHROPLASTY, WITH VITALLIUM CAP.** Kellogg Speed. *Western Journal of Surgery, Obstetrics and Gynecology*, XLVIII, 101, Feb. 1940.

Arthroplasty of the hip by the use of a vitallium cap, properly fitted over the prepared femoral head according to the technique of Smith-Petersen, is excellently illustrated and described. The results of two recent cases are analyzed.

The author believes that this method of arthroplasty is a definite advance over previous methods and sees the possibility of its being extended in modification to the shoulder joint, the head of the radius, and possibly other joints.—*F. Harold Downing, M.D., Fresno, California.*

**CHONDRODYSTROPHIA CALCIFICANS CONGENITA.** Erich Kampf. *Zeitschrift für Kinderheilkunde*, LXI, 124, 1939.

The author describes a variety of chondrodystrophy which he calls "chondrodystrophia calcificans congenita". He reports the case of an infant, three months old, who presented flattening of the skull and shortening of the left femur and humerus, although both arms were rather short. The roentgenographic findings were remarkable in that many kernel-like calcified deposits were seen in the shoulder, elbow, hip, and knee joints. The vertebrae also showed these calcified deposits about their epiphyses. There was also epiphyseal distortion. This is a case of typical foetal chondrodystrophy, with the short plump bones showing dense cortices and thinned-out marrow and the unusual kernel-like ossified cartilaginous bodies. The author cites Dietrich's explanation for this, namely, cartilaginous destruction with replacement by connective tissue and deposition of calcium. There is no disturbance in the periosteal ossification.—*A. I. Blieden, M.D., Iowa City, Iowa.*

**ÜBER DIE OSTEOCHONDRITIS ISCHIO-PUBICA (Ischiopubic Osteochondritis).** Wilhelm Wilken. *Zeitschrift für Kinderheilkunde*, LXI, 127, 1939.

The author reports a case of ischiopubic osteochondritis. There are only a few such cases recorded in the literature. The clinical picture is that of involvement of the hip. The disease occurs between the ages of eight and twelve. Locally there is tenderness over the pubis or ischium, occasionally accompanied by redness or swelling. Roentgenographic examination rules out hip disease. In the roentgenogram a round swelling, about the size of a cherry, is noted on the boundary between the pubis and the ischium. Pathologically this is a disturbance in the ossification center between the pubis and the ischium. Van Neck found this to be a true osteochondritis. The condition heals in most cases without any especial treatment.—*A. I. Blieden, M.D., Iowa City, Iowa.*

DIE DRAHTEXTENSION IN DER BEHANDLUNG DER FRAKTUREN, LUXATIONEN UND KONTRACTUREN MIT BESONDERER BERÜCKSICHTIGUNG DER KOMPLIKATIONEN (Wire Extension in the Treatment of Fractures, Luxations, and Contractures with Special Reference to Complications). H. J. Lauber, B. Klapp, und M. Siuts. *Zentralblatt für Chirurgie*, LXVI, 2265, 1939.

The article is based on eleven years' experience in the treatment of 796 patients, in which wire extension was employed 812 times. In one case only was there a complication (osteomyelitis). If other authors report unsatisfactory results and the development of osteomyelitis, following this method, insufficient wire fixation is probably the cause. (The great advantage of wire extension over extension with adhesive tape is the avoidance of decubiti and skin lesions.) Wire extension is believed to be as efficient as or even better than open osteosynthesis, because the latter retards normal callus formation, creates greater opportunity for infection, and requires considerable experience on the part of the surgeon.—*Ernest H. Bettmann, M.D., White Plains, New York.*

ERFAHRUNGEN BEI DER LUXATION DES RADIUSKÖPFCHENS JUGENDLICHER GELENKE (Experiences with Luxation of the Head of the Radius in Young Persons). Walther Müller. *Zentralblatt für Chirurgie*, LXVI, 2319, 1939.

In cases of early luxation of the radius, there is an increase in length, due to the absence of pressure normally exerted by the adjacent bones. In cases of resection of the head of the radius, on the contrary, there occurs a hypertrophy of the distal end of the radius with a resultant disproportion between the length of the ulna and that of the radius. Therefore, resection of the head of the radius is contra-indicated especially in children. The following method is recommended for reduction of older dislocations of the proximal end of the radius: incision over the elbow joint in front of the head of the radius, blunt distraction of the muscles, and reposition of the head of the radius after incision of the joint capsule. In order to secure the correct position, the author carries two silk threads around the neck of the radius; the ends of these threads penetrate the dorsal joint surface near the olecranon. After closure of the anterior wound, the threads are knotted over a well-padded sterile wooden peg, thus preventing further slipping of the radial head. This temporary fixation is removed after three weeks.—*Ernest H. Bettmann, M.D., White Plains, New York.*

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Bulletin of the Hospital for Joint Diseases (New York, N. Y.), I, No. 1, 1940.

The Child (Washington, D. C.), IV, No. 6 and Supplement, 1939; IV, Nos. 7 and 9, 1940.

Current Medical Digest (Baltimore, Md.), VI, Oct. 1939.

El pie talo poliomiéltico y su tratamiento. Dr. Vicente Sanchis Olmos. Madrid, Espasa-Calpe, 1940.

Infantile Paralysis (Van Nuys, Calif.), I, No. 7, 1939.

Publications from the Department of Orthopaedic Surgery, University of Oklahoma School of Medicine. Vol. I, 1938-1939. Bound and Distributed by the Oklahoma Commission for Crippled Children.

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Revista Cubana de Obstetricia y Ginecologia (Habana, Cuba), I, No. 3, 1939.

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The Rotarian (Chicago, Ill.), LVI, No. 3, 1940.

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The Tohoku Journal of Experimental Medicine, XXXVII, Nos. 1, 2, 3, and 4, 1939; XXXVII, No. 5, 1940.

Vida Nueva (Habana, Cuba), XLIV, No. 6, 1939; XLV, No. 1, 1940.





